Mathematics Comics Based on Problem-Based Learning with Illustrations of Jambi Culture

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ARTICLE INFO	ABSTRACT
	Purpose— This research is important to overcome the low interest of students in learning mathematics in elementary schools due to the conventional approach, which is less interesting. By developing comics based on Problem-Based Learning (PBL) that promote local Jambi culture, this research aims to create more interesting, contextual, and relevant learning and increase the interest of fifth-grade students in mathematics. **Methodology-** This research and development (R&D) approach uses the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), which was employed to design the mathematics comics. Data were collected through pre-test and post-tests, observations, interviews, questionnaires, and documentation. These comics were developed based on a needs analysis derived from teacher interviews and student feedback, focusing on integrating local cultural aspects, particularly the Gentala Arasy temple, to make the learning material more engaging and relevant. Conducted during the 2024/2025 academic year at SDN 151/IV Jambi City, this research involved 42 students from two selected classes. **Findings-** The findings indicate that the developed PBL-based comic media was feasible and effective in supporting mathematics learning. Including Jambi cultural illustrations proved valuable in increasing student engagement, motivation, and understanding of mathematical concepts. The comic's visual and narrative elements helped simplify abstract mathematical ideas, making them more accessible and comprehensible for elementary school students. Feedback from both experts and students affirmed the comics' validity, readability, and overall effectiveness in enhancing learning outcomes. This study demonstrates that culturally contextualized comic media can significantly improve students' interest and achievement in mathematics. **Significance-** The developed comics offer an innovative solution for mathematics education and contribute to the advancement of local culture-based educational tools, providing valuable resources for teachers and students in Jambi and other regions.

INTRODUCTION

Mathematics education is one of the important pillars of the education system in Indonesia. Because of its unique and challenging nature, mathematics plays an important role in improving and developing the quality of human resources in education (Indrawati, 2023). A mathematics teacher must provide effective and efficient learning so students can connect the knowledge gained with the surrounding environment and become creative and innovative human resources in solving problems. Mathematics teaches numeracy skills and trains students to think logically, critically, and systematically and work together (Fathani, 2016).

However, the main challenge in learning mathematics in elementary schools is students' low interest in learning. This can be seen when the author made observations at SDN 151/IV Jambi City by observing student behavior during mathematics lessons, such as lack of participation in mathematics learning, lack of attention in the learning process, and lack of involvement in carrying out tasks given by the teacher. This was strengthened through interviews conducted by researchers with class V teachers at SDN 151/IV Jambi City, where information was obtained that students were weak in learning mathematics. Students cannot yet think and reason mathematically well when solving mathematical problems. When studying mathematics, most students do not understand the use of mathematical concepts well; instead, students only remember formulas, so if students are given questions different from the example questions explained by the teacher, they will find it complex and confusing to solve the questions given. Apart from that, information was obtained that in the mathematics learning process in the classroom, teachers taught only using mathematics textbooks provided by the school. The lack of other supporting learning media that can help students learn mathematics and teachers' lack of skill in developing innovative learning media in mathematics lessons makes teaching mathematics challenging.

To overcome this problem, innovative learning approaches are needed to increase student interest and motivation to learn. One potential approach is using comics as a learning medium (Anib Dwi Saputro, 2015) ; (Shomad & Rahayu, 2022). Comics have high visual appeal and can convey mathematical concepts more interestingly and easily. (Subroto et al., 2020) it is easier for readers to understand the comic storyline because it uses everyday language that is easy to understand. Comics attract readers' interest in reading the text because they are accompanied by interesting pictures (Putro & Setyadi, 2022). Types of comics include: 1) Comic books, 2) Online comics (Web Comic), 3) Cartoons/caricatures (Cartoon), 4) Annual comics, and 5) Comic strips. Using comics as a learning medium aims to provide a new nuance to learning (Mikamahuly et al., 2023) ; (Nugroho, 2023). Additionally, using comics in learning can increase students' interest and make it easier to remember the subject (Nugraheni, 2017).

Integrating local cultural elements in learning media can also provide added value (Hanik & Nurtamam, 2017). With its rich traditions and local wisdom, Jambi culture can be used as illustrations in mathematics comics to make learning more relevant and contextual for students. Using Jambi cultural illustrations can increase students' engagement with the material being studied and enrich their insight into local culture.

Comics will be more effectively implemented in mathematics learning if designed using the right learning model. Therefore, a learning model is needed to develop students' thinking skills, help them carry out the learning process, and help them apply their knowledge in problem-solving. One of the learning models in question is the Problem-Based Learning (PBL) model. (Suherman, 2003) PBL is a learning model that uses real-world problems as a context for students to learn critical thinking and problem-solving skills. Previous research (Ritonga, 2023) showed increased students' interest in learning mathematics using the PBL model assisted by comic media at SMPN 7 Medan. Comic media assisted the focus of the research on the PBL model to increase students' interest in learning mathematics in junior high schools.

The results achieved by comic media effectively increased students' interest in learning at the junior high school level. This research is limited to the junior high school level without considering local cultural elements. Research conducted by (Wati, 2022) focuses on the influence of the Problem-Based Learning (PBL) model assisted by comic media on students' Mathematics knowledge competencies; the results obtained by PBL with comics positively influence students' understanding of concepts. This study does not integrate

local cultural elements as a learning context. Arliani, S. P., & Khabibah, S. (2022) focused on developing digital mathematical comics with an ethnomathematics approach for the material of converting units of weight from g to kg and vice versa for grade III Elementary Schools; the results of the study met the criteria for validity, practicality, and effectiveness and improved learning outcomes. This study is limited to specific materials and does not use certain learning models like PBL.

Furthermore, Buchori, A., & Murtianto, Y. H. (2017) focused on conducting research on the development of mathematical comics with an ethnomathematics approach to cube and block material in junior high schools, the results of the product effectiveness test from the experimental class learning outcomes were better than the control class, this study did not use the PBL model and was not relevant to the elementary school level. Cahyono, B., Rohman, A. A., & Setyawati, R. D. (2023), the focus of research on the development of e-comic learning media based on Ethnomathematics and creative thinking skills in geometry material, the results of e-comics are declared suitable for use because they meet the criteria of validity, practicality, and effectiveness. This study has not specifically combined PBL with local culture as a learning context.

This study offers novelty with the integration of local Jambi culture. Unlike previous studies, comics are developed by raising elements of local Jambi culture as a learning context. This is relevant to building student connectivity with learning. This study combines explicitly comic media with the PBL model, which has not been widely studied in the context of local culture at the elementary school level. Suherman (2003) stated that PBL effectively trains critical thinking and problem solving while Trianto (2011) emphasized that PBL is very relevant for learning based on actual problems, including integrating local culture. This study focuses on increasing the learning interest of fifth-grade elementary school students, which has rarely been the center of attention in previous studies. This aligns with Rusman (2012), who said contextual-based media, such as comics with local culture, can make learning more enjoyable. This study aims to develop and evaluate mathematical comics based on Problem-Based Learning with Jambi cultural illustrations to increase elementary school students' interest in learning. Through this study, it is expected that practical solutions can be found to increase students' interest in learning mathematics by using engaging and contextual comic media.

METHODOLOGY

The type of research used in this research is Research and Development (R & D). The development model used was the ADDIE model, which consists of five stages, namely (*Analysis, Design, Development, Implementation, and Evaluation*) model, (Winaryati et al., 2021). The research scheme is illustrated in Figure 1. This model was chosen because of its systematic nature, making it suitable for producing products in mathematical comics based on Problem-Based Learning with Jambi cultural illustrations. According to (Branch, 2009), the ADDIE development model is a product development paradigm where the application of ADDIE to learning facilitates the deliberate complexity of the learning environment by responding to various situations, interactions within contexts, and interactions between contexts. The product developed in this research is a mathematics comic based on problem-based learning with illustrations of Jambi culture.

This research was conducted in the odd semester of the 2024/2025 school year in class V of an elementary school at SDN 151/IV Kota Jambi, Jambi. The subject population in this study consisted of four parallel classes with 110 fifth-grade students, and the samples were taken from two classes totaling 42 students. Sampling was done using a purposive sampling technique, not wholly randomized, because previously, there was already a class division. The research data used came from teachers, students, and expert lecturers. The types of data used are qualitative and quantitative data. Data collection used test and non-test techniques. The test techniques were pre-test and post-test, while the non-test techniques were observation, interview, questionnaire, and documentation.
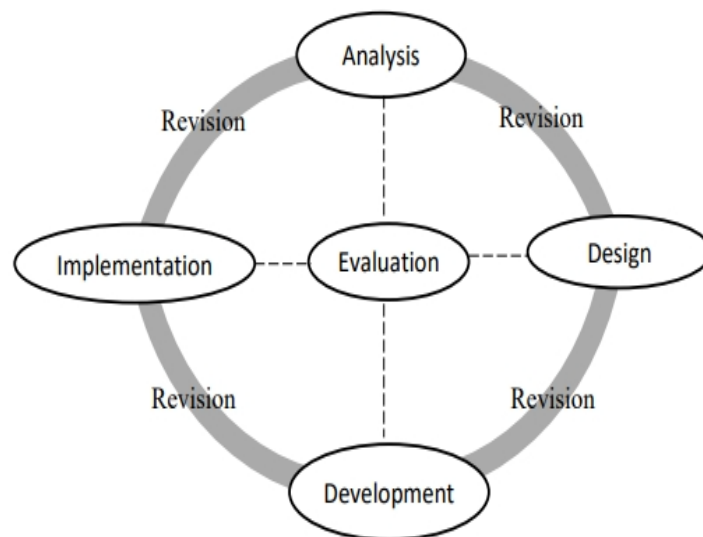
Figure 1. ADDIE model diagram

The first stage of the research was analysis; researchers identified problems and analyzed needs based on data obtained through interviews and needs questionnaires. The needs analysis questionnaire used the grids in Table 1.

Table 1. Teacher and Student Needs Analysis Questionnaire Grid

Indicators	Aspects	Number Of Items
Teacher Needs	Suitability of Media to Curriculum	1
	Student's interest in using existing learning media	1
	Ease of use of media	1
	The importance of visual media, such as comics, in helping students understand mathematical concepts	1
Student Needs	Interest in Learning Mathematics	1
	Students like visual media such as comics in learning	1
	How interesting would it be for students if learning media had illustrations of local culture, such as Jambi culture	1
	Do students like learning with a problem-solving approach like problem-based learning	1

Second, in the design stage, researchers designed learning media based on the results of problem identification and the needs analysis questionnaire of teachers and students. Researchers collected reference sources of learning content and illustrative images and designed the concept of learning media design. The design and illustrative images were created using the Canva application.

Third, during the development stage, the researcher developed the design by combining the drafts that had been made. Then, experts conducted the product validation test to determine the feasibility of the product that had been developed. The expert validation sheet used guidelines that can be seen in Tables 2 and 3 and employed a 1-5 Likert scale assessment criteria (Sugiyono, 2013), which can be seen in Table 4.

Table 2. Product Validity Criteria ((Burhannudin Milama, Safinah Adiliyah, 2023)

Aspects	Number Of Items
Content eligibility	5
Feasibility of learning presentation	5
Linguistic appropriateness	5
Problem-based learning model	5
Presentation	5

Table 3. Media Expert Validation Instrument Grid ((Burhannudin Milama, Safinah Adiliyah, 2023)

Aspects	Number Of Items
Presentation Feasibility	6
Linguistik Appropriateness	5
Graphics feasibility	5

Table 4. Validation Assessment Criteria ((Burhannudin Milama, Safinah Adiliyah, 2023)

Score	Percentage (%)	Criteria of validity
1	0-20	Revision required
2	21-40	Less
3	41-60	Fair
4	61-80	Valid
5	81-100	Advanced

Fourth, at the implementation stage, researchers tested flipbook learning media. This test employed a *quasi-experimental pretest-posttest control group design* method. The experimental class used a VA class with 22 students, and the control class used a VC class with 20 students. The implementation stages involved administering pre-tests to both classes and then implementing learning with PBL-based flipbook media in the experimental class. The control classes did not use flipbook media. Finally, post-tests were administered to both classes. To determine the effectiveness of the media, researchers conducted a quantitative analysis based on the average difference with the independent sample t-test and N-gain test using SPSS version 20. Decision-making was based on the guidelines in Table 5 and Table 6.

Table 5. Criteria for Interpretation of Independent Samples T-Test Results ((Muhid, 2019)

Results	Interpretation	Conclusion
Significance < 0.05	H_0 rejected	There is a significant difference
Significance > 0.05	H_0 Accepted	There is no significant difference

Table 6. Criteria for Interpretation of N-Gain Results (Supriadi, 2021)

Score	Criteria
N Gain <0.3	Low
$0.3 \leq$ N Gain < 0.7	Medium
N Gain $\geq$ 0.7	High

Fifth, an evaluation was conducted to evaluate the development carried out and to find out the users' response to the learning media developed. User responses to the media were based on teacher and student response questionnaires with the grids in Tables 7 and 8.

The data and information to be obtained and analyzed in this research were taken using research instruments in the form of questionnaires and tests. Questionnaires are used to test the validity and practicality of learning media. Meanwhile, tests are used to test effectiveness by comparing the pre-test and post-test results. To test the validity and practicality, analysis is used using the formula:

$$P\ (s) = \frac{S}{N} \times 100\% \qquad (1)$$

Description:
P: Percentage of validity
S: total score obtained and
N: maximum score (Putro & Setyadi, 2022)

Table 7a. Teacher Response Questionnaire Grid (Nesri, 2020)

Alidity Presentation	Level Of Validity
85.01 % - 100 %	Very High
70.01 % - 85.00 %	High
50.01 % - 70.00 %	Medium
01.00 % - 50.00 %	Low

Table 7b. Student Response Questionnaire Grid (Burhannudin Milama, Safinah Adiliyah, 2023)

Score average interval	Category
81.25 % < Skor ≤ 100%	Very Good
62.50 % < Skor ≤ 81.25 %	Good
43.75 % < Skor ≤ 62.5 %	Not so good
25 % < Skor ≤ 43.75 %	Not good

Next, testing the effectiveness of the pre-test and post-test using the Paired-Sample T-Test, which will be analyzed using SPSS software

FINDINGS

The results of this development research were mathematics comics based on problem-based learning with illustrations of Jambi culture. Research and development were conducted using the ADDIE model, which has five stages: analysis, design, development, implementation, and evaluation.

Analysis Stage

At the analysis stage, researchers conducted teacher interviews and provided a needs questionnaire to collect data related to learning problems. Information obtained through interviews shows there were problems, namely the lack of various learning media to support mathematics learning and teachers who often used textbooks and worksheets. In addition, there were also students whose scores had not reached the completeness criteria. Furthermore, the teacher and student needs questionnaire results show that teachers and students need innovative learning media to support mathematic learning. Through the analysis of interviews and questionnaires, information was also obtained on learning outcomes that needed to be developed, student characteristics, and student learning outcomes. Thus, the results of this analysis stage could be used as a reference for designing the products needed in the next stage.

Design Stage

The second stage focused on design. Researchers designed products based on the results of the analysis stage. Here, the researcher determined learning objectives and content adapted to those objectives. I also designed the comic media, including the layout and color scheme. Canva was used to create a draft layout and write the content. In this stage, the researcher begins to design the story that will be included in the comic. This story must, of course, contain a learning objective plot (ATP). The initial step in determining the comic's title is "Mathematical Adventures in Jambi Country: Learning with Stories and Culture," based on Jambi culture using Problem-Based Learning. After obtaining an appropriate title, the next step is to collect material references. The next step is to arrange the comic outline.

In the design stage, the steps taken are compiling a comic framework in the form of scripts, menu page designs, reading guides, button designs, and character designs. The comic script contains storylines and character dialogues. The prepared storyline contains an ethnomathematics approach established at the analysis stage. Dialogue between characters uses simple standard Indonesian so that students can easily understand. The menu page design has several menu options: ' Character Introduction,' 'KD and Indicator,' and 'Start Reading.' In the choice of character introduction, readers can get acquainted briefly with the characters in the comics. Because the comics are intended for elementary school fifth graders, the characters in the story are also depicted in grade V elementary school. It aims to attract the attention of students.

Readers can see the CP and ATP learned in the comics in the' CP and ATP' option. To start reading, readers can select 'Start Reading'.

At this stage, the researcher also designs validation sheets, practicality and effectiveness sheets, questionnaires, and tests that will be used to test and assess the learning media being developed.
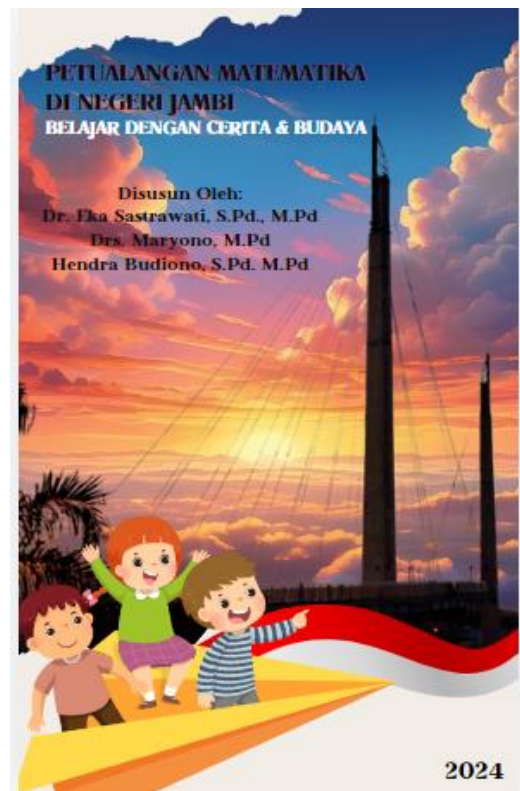

Figure 1. Comic Cover

Development Stage

The third stage was development. The layout and text provided are also done using the Canva application. Some reasons for choosing the Canva application to design comics in this study include Canva has a user-friendly interface that makes it easy for users, including beginners, to design comics without the need for in-depth technical skills in graphic design; Canva provides various templates, graphic elements, fonts, and illustrations that support the creation of comics quickly and easily. The drag-and-drop feature allows the design process to be more practical; Canva allows customization of design elements according to needs, including inserting local cultural illustrations such as typical Jambi elements to make comics more contextual; Canva can be accessed via various devices, both laptops and smartphones, making the design process easier anytime and anywhere; Canva supports high-resolution design exports, so that the resulting comics have good visual quality, are attractive, and suitable for use in learning.

This process produces comic image stages, providing basic colors and light, dark, or shading. The colored image is then positioned so that it fits on the specified page. Text is provided for each conversation dialogue and material, questions, and discussions on the specified page. Once each page is ready with images and text, it is then arranged based on the comic framework that has been created. The mathematical content developed about flat shapes is understanding the properties of shapes and the relationships between shapes. The researchers prepared a draft of PBL-based comic learning media, which was then validated by content and media experts (lecturers) to determine the feasibility. Figure 2 displays the final results of the comic media development. The results of the assessment from these experts are shown in Table 8. These validation results were then used to improve and refine the PBL-based comic media draft before the test. The

development process culminated in a final product: comic media, "Mathematical Adventures in Jambi Country: Learning with Stories and Culture," based on the design that was created.

Figure 2. Comic content

Table 8 shows the results of the validity tests for the material, media, and language comic material and media "Mathematical Adventures in Jambi Country: Learning with Stories and Culture."

Table 8. Material and language validity test results

Variable	Assessment Aspects	Percentage	Category
Material	Compliance of material with indicators	85	Valid
	The truth of the concept of each material	89	Valid
	The image displayed corresponds to the indicator	84	Valid
	Ease of understanding the material	84	Valid
Material average		85.2	Valid
Media Illustration	Neat layout of the story sequence	85	Valid
	Accuracy in character selection	85	Valid
	Image attractiveness	87	Valid
	Accurate placement of speech balloons	84	Valid
	Selection of letter colors	85	Valid
	Selecting font size	87	Valid
	Image size compatibility	87	Valid
Average media illustration		85.7	Valid
Language	Suitability of the language used with elementary school students' language abilities	88	Valid
	The language used is easy to understand	87	Valid
	The grammar used corresponds to perfect spelling	85	Valid
	Appropriate conversational language with the characters	86	Valid
	The language used is communicative	87	Valid
Language average		86.6	Valid
Average		85.93	Valid

Based on the results of the material and language validity test in Table 8, several findings were obtained as follows: in the material aspect, validity was tested through several indicators. The suitability of the material with the indicators obtained a percentage of 85%, the correctness of the concept of each material reached 89%, the suitability of the images with the indicators obtained 84%, and the ease of understanding the material was also assessed at 84%. Overall, the average validity of the material reached 85.2% with a valid category.

Regarding media illustration, the story's layout was assessed as neat with a percentage of 85%, the accuracy of character selection reached 85%, the attractiveness of the image was 87%, and the accuracy of the speech balloon placement was 84%. In addition, the selection of letter colors obtained a score of 85%, the selection of letter size 87%, and the suitability of the image size also received 87%. The average validity of media illustrations was 85.7% with a valid category.

Meanwhile, in the language aspect, the suitability of the language with the abilities of elementary school students obtained a score of 88%, the ease of understanding the language was 87%, and the suitability of grammar with correct spelling received 85%. In addition, the suitability of the spoken language with the character obtained a value of 86%, and the level of language communication in the media reached 87%. Thus, the average validity of the language aspect is 86.6% with a valid category. Overall, the material and language validity test results obtained an average of 85.93%, indicating that the teaching materials tested are included in the valid category for use.

The validity test results for media, material, and language produced a percentage of 85.93% (less than 90%), which means it is in the valid category. From these results, it is concluded that in terms of media, material, and language, the comic "Mathematical Adventures in Jambi Country: Learning with Stories and Culture" is valid.

Implementation Stage

In the implementation stage, a test was conducted using the quasi-experimental pretest-posttest control group design method. The experimental class consisted of the VA class with 22 students, and the control class consisted of the VC class with 20 students. The implementation stages involved giving pre-tests to both

classes and implementing learning with PBL-based comic media in the experimental classes, while the control classes did not use comic media. Finally, post-tests were administered to both classes. The pre-test and post-test results can be seen in Table 9 and Table 10.

Table 9. Experiment Class and Control Class Pre-Test Score Results

Class	Number of Students	Mean	Min	Max
Experiment	22	64.50	45	88
Control	20	62.78	37	82

In the pre-test stage in Table 9, the experimental class consisted of 22 students with an average score of 64.50. The lowest score obtained by students in the experimental class was 45, while the highest score reached 88. Meanwhile, the control class, consisting of 20 students, had an average pre-test score of 62.78, with the lowest score of 37 and the highest score of 82.

Table 10. Experiment Class and Control Class Post-Test Score Results

Class	Number of Students	Mean	Min	Max
Experiment	22	83.60	88	98
Control	20	73.20	76	84

After implementing the treatment in the study Table 10, the post-test results showed increased scores in both classes. The experimental class recorded an average post-test score of 83.60, with the lowest score of 88 and the highest score of 98. The control class had an average post-test score of 73.20, with the lowest score of 76 and the highest score of 84. These results show that the t class experienced a more significant score increase than the control class.

Next, an independent sample t-test was conducted for the pre-test, and a difference test was administered for the post-test. Before administering the post-test difference test, an independent sample t-test was conducted first to determine the initial ability of the control and experimental classes. The results of the independent sample t-test based on the experimental and control class pre-test are shown in Table 11.

Table 11. Pretes Independent Sample T-test of Experimental and Control Classes

Test	Results	Decision
Normality	Experiment = Sig. 0.47	H_0 accepted
	Control = Sig. 0.13	
Homogeneity	Sig. 0.35	H_0 accepted
Independent	$_{count}$ = 0.29	H_0 accepted
Sample test	df = 40; t_{table} = 1.68; Sig. 0.77	

Based on the results of the Independent Sample T-test on the pre-test of the experimental class and the control class in Table 11, the following results were obtained: in the normality test, the experimental class has a significance value of 0.47, while the control class has a value of 0.13. Because both significance values are more significant than 0.05, then H_0 is accepted, meaning the data in both classes are typically distributed. In the homogeneity test, a significance value of 0.35 was obtained. Because this value is more significant than 0.05, then H_0 is accepted, indicating that the data variance between the experimental and control classes is homogeneous. The Independent Sample T-test obtained a t-count value of 0.29, with a degree of freedom (df) of 40 and a t-table of 1.68. The significance value obtained is 0.77. Because the t-count is smaller than the t table, then H_0 is accepted, which means that there is no significant difference between the pre-test values of the experimental class and the control class before the treatment was given. In conclusion, the analysis results show that before the treatment was given, both classes had equivalent initial conditions in terms of normality, homogeneity, and pre-test results. This indicates that any changes in learning outcomes after treatment are most likely caused by the treatment given in the study.

Furthermore, an effectiveness test was conducted to determine the effectiveness of using PBL-based comic learning media in improving student learning outcomes. Previously, prerequisite tests were conducted, which

included normality and homogeneity tests. Details of the prerequisite test results and effectiveness test are shown in Table 12.

Table 12. Pretes Independent Sample T-test of Experimental and Control Classes

Test	Results	Decision
Normality	Experiment = Sig. 0.24	H_0 accepted
	Control = Sig. 0.26	
Homogeneity	Sig. 0.05	H_0 accepted
Independent	$_{count}$ = 2.90	H_0 accepted
Sample test	df = 40; t_{-tabel} = 1.68; Sig. 0.01	
N-Gain	Experiment = 0.68	Medium
	Control – 0.42	Medium

Based on the results of the Independent Sample T-test on the pre-test of the experimental class and the control class in Table 12, the following results were obtained: in the normality test, the significance value of the experimental class is 0.24, while the control class is 0.26. Because the significance value of both classes is greater than 0.05, then H_0 is accepted, which means that the data in both classes are typically distributed. In the homogeneity test, a significance value of 0.05 was obtained. With this value, H_0 is accepted, indicating that the data variance between the experimental and control classes is homogeneous or has the same variance. In the Independent Sample T-test, the calculated t-value was 2.90 with a degree of freedom (df) of 40. The t-table value was 1.68 with a significance level of 0.01. Because the calculated t value is greater than the t table, then H_0 is accepted, which means that there is no significant difference between the pre-test values of the experimental class and the control class before the treatment was given.

The results of the N-Gain analysis showed that the experimental class had a value of 0.68 and the control class 0.42. Based on the N-Gain increase category, both classes were included in the moderate category, but the experimental class experienced a higher increase than the control class. In conclusion, before the treatment, both classes had comparable initial conditions regarding normality, homogeneity, and pre-test results. However, after the treatment, the increase in learning outcomes in the experimental class was higher than in the control class.

Evaluation Stage

The next stage was evaluation, which involved responses and input from students and teachers. The results of the response questionnaire showed that the experimental class teachers and students gave a perfect average score of 91%, as seen in Table 13.

Table 13. Results of Teacher and Student Responses

Response	Score (%)	Criteria
Teacher	95	Very good
Students	92	Very good
Average	93.5	Very good

Based on the results of the analysis of teacher and student responses to the implementation of learning in Table 13, the following results were obtained: the teacher's response showed a high level of satisfaction, with a score of 95%, which is included in the very good category. Meanwhile, the students' responses also showed positive results, with a score of 92%, which is also in the excellent category. Overall, the average response score from teachers and students reached 93.5%, which is included in the excellent category. This shows that teachers and students responded very positively to the use of learning comic media applied in the study.

DISCUSSION

The final result of this research and development was a problem-based learning comic media on two-dimensional figural content for grade V elementary school. The PBL-based comic media developed proved

feasible and effective in supporting mathematics learning in grade V elementary school. This comic media was developed based on the results of analyzing teacher interviews, and student needs in the VA class of an elementary school at SDN 151/V Kota Jambi, which showed that comic learning media was needed to support learning. In learning activities, everything could be used as a medium or intermediary to support the learning process, with a note that the media could facilitate and streamline the learning process (Cahyadi, 2019). Good learning media could present abstract concepts easily understood (Rahayu et al., 2022). Using learning media could stimulate students' thoughts, motivation, and interest to support the achievement of learning objectives (Nurdyansyah, 2019). Various learning resources, both conventional (print) and digital (non-print), were needed to support the learning process (Damasanti & Nuroh, 2023). After going through the learning process, students got changes that were referred to as learning outcomes in terms of knowledge, skills, and attitudes (Ananda & Hayati, 2020). One of the factors that influenced learning outcomes was the use of learning media (Astiti et al., 2021).

The product produced from this study is Mathematics Comics Based on Problem-Based Learning with Illustrations of Jambi Culture. This comic has passed a feasibility test by experts and students. The development process follows the ADDIE model. The study results indicate that this digital comic is feasible and effective for learning. The feasibility of this product is based on its adjustment to the characteristics and learning needs of students. The analysis shows that many students find it difficult and less interested in learning mathematics. Teachers also expressed the need to learn more interesting and relevant media to the local cultural context. Muaro Jambi Temple was chosen as a cultural background because it has rich historical and cultural values and is relevant to students' daily lives in Jambi. Elementary school students are at the concrete operational stage in their cognitive development (Agung, 2019), so they need media that can concretize information because they cannot think abstractly (Intan Putri Karina Ramadhani & Erman, 2019). Therefore, using digital comics in learning effectively solves students' learning difficulties (Wulandari et al., 2023).

Another factor that supports the feasibility of this ethnomathematics-based digital comic is the quality of the learning materials, which are considered very good. The material presented in this comic has been arranged according to the curriculum, including the learning achievements and objectives, so in this aspect, the comic received a very good assessment.

This comic script was prepared by combining mathematical concepts relevant to elementary school students with local cultural elements, especially Gentala Arasy Jambi. The initial stage involved collecting information about mathematical materials by learning needs, such as the properties of flat shapes and the relationships between shapes. This information was then integrated with an interesting and fun story, using the background of Gentala Arasy Jambi to create a contextual learning experience that touches students' daily lives. Next, a storyboard was prepared that contained a detailed storyline, including dialogue, illustrations, and problem-solving activities. This storyboard became the leading guide in developing the comic, ensuring that every element of the story and visuals supported students' understanding of the mathematical concepts being taught. This process was designed to make the comic educational and attract students' attention by exploring local Jambi culture.

Furthermore, this digital comic received excellent design qualifications. This media was designed by adopting the genitalia easy Ethnomathematics in Jambi (Anggreyani et al., 2024; Monika et al., 2024). The illustrations used in the comics are designed to attract students' interest and help them understand mathematical concepts in a more visual and contextual way (Ardiansyah & Setyadi, 2014).

The validation process involves assessing the comics' validity, readability, and acceptability. The validators provide constructive feedback on the content and illustrations. Some suggestions for improvement include adjusting the language, simplifying mathematical concepts, and improving the quality of the illustrations.

After revisions based on input from the validators, the comic prototype was tested on fourth-grade students in several elementary schools in Jambi. This trial aims to measure the effectiveness of the comics in increasing students' interest in learning mathematics.

The final stage in this research is dissemination, where the revised and tested ethnomathematics comics are distributed to other elementary schools in Jambi. This process begins with presenting the research results to teachers in Jambi through seminars or workshops to increase their awareness and acceptance of using comics as an innovative learning medium. Furthermore, the comics that have been developed are distributed to various elementary schools in Jambi to be used in mathematics learning so that more students can feel the benefits. In addition, the results of this research are also published in educational journals, allowing the findings and best practices resulting from this research to be shared with the broader education community while contributing to the development of creative and effective learning methods.

Using ethnomathematics comics illustrated by Gentala Arasy Jambi effectively increases students' interest in mathematics. The questionnaires filled out by students showed a significant increase in interest and motivation to learn. Students felt that learning mathematics with the comics became more interesting and enjoyable. In addition, interviews with teachers showed that this comic helped students understand mathematical concepts better and made them more involved in the learning process.

This comic not only functions as a mathematics learning aid but also introduces and preserves local culture to students. The integration of mathematics and local culture in this comic shows that the ethnomathematics approach can be an effective learning strategy.

Overall, the development of this ethnomathematics comic illustrated by Gentala Arasy successfully met the research objectives of increasing elementary school student's interest in learning mathematics. This research also contributes positively to innovation in learning media that combines cultural and educational aspects. The results of this study can be a reference for the development of other learning media based on local culture.

After the analysis was carried out based on the validation results and readability of the comics developed, the comics developed were declared to have met the criteria worthy of being called the final prototype for the development of shape material comics based on Jambi cultural Ethnomathematics for grade V of elementary school. This study implies that it can increase the variety of feasible learning media available and can be used by teachers, students, schools, and parents as learning media. The comics developed are expected to help attract students' interest and maximize their learning outcomes, such as the experiences of several researchers. Comics influence students' learning outcomes and reading interests in science subjects (Widyawati & Wijayanti, 2019); (Chung et al., 2016); (Kerneža & Košir, 2016). Comics can facilitate student learning, such as cognitive development, motivation, and information processing (McLaughlin & Bell, 2002). In addition, the development of comics based on Jambi ethnomathematics adds to the wealth of comics based on Nusantara culture as has been developed by (Nida et al., 2017) (Fitrianingsih et al., 2019) (Wahid et al., 2020). The comic media developed also enriches ethnomathematics research on Jambi Culture.

CONCLUSION

Based on the stages in the ADDIE development model, a product was produced in the form of a learning comic with the title "Mathematical Adventures in Jambi Country: Learning with Stories and Culture" with a validity percentage of 85.93%, which means it is valid and a practicality percentage of 94.3% which is included in the convenient category. The conclusion is that the comic "Mathematical Adventures in Jambi Country: Learning with Stories and Culture" is effective for use in learning. Suggestions for future researchers to develop mathematics comics using other material discussions This study successfully developed and evaluated a Problem-Based Learning (PBL)-based mathematics comic, enriched with Jambi cultural illustrations, to enhance elementary school students' engagement and understanding of mathematical concepts. Furthermore, expert validation and student feedback confirmed the high validity and practicality of the comics, with positive responses from both teachers and students. The experimental group that utilized the comics demonstrated a substantial improvement in mathematics achievement compared to the control group, reinforcing the effectiveness of this approach. The integration of local cultural elements, such as the Gentala Arasy temple, rendered abstract mathematical concepts more relatable

and accessible, thereby enhancing their perceived comprehensibility. Combining PBL with culturally contextualized content significantly augmented student motivation and participation levels, enhancing learning outcomes. The experimental group that utilized the comic exhibited a substantial improvement in mathematics achievement compared to the control group. This research underscores the significance of culturally relevant teaching materials in promoting heightened student engagement and mitigating the gap between abstract concepts and their real-life applications. The comic facilitated a more profound comprehension of mathematics and promoted awareness and appreciation of local cultural heritage. This suggests combining educational innovation with cultural context can create more meaningful student learning experiences.

In conclusion, the PBL-based mathematics comic with Jambi cultural illustrations effectively enhances students' interest and improves learning outcomes in mathematics. Future studies could further explore the broader application of similar ethnomathematics-based resources across other subjects and regions to assess their long-term effects on academic achievement and cultural awareness. In conclusion, the Mathematics Comics Based on PBL with Jambi Cultural Illustrations is an effective educational tool that enhances mathematical learning outcomes and promotes cultural appreciation. Future research can further explore the application of ethnomathematics-based resources in different regions to assess their long-term impact on student achievement and cultural awareness.

REFERENCES

Ananda, R., & Hayati, F. (2020). *Variabel belajar (kompilasi konsep)*. Pusdikra MJ.

Anib Dwi Saputro. (2015). Aplikasi Komik sebagai Media. *Studi Kependidikan Dan Keislaman*, *05*(ISSN 2088-3390), 1–19.

Arrum, A. R., & Nurdyansyah, N. (2023). Development of Digital Flipbook Media to Improve Students' Understanding of Social Studies Subjects Grade 5 Madrasah Ibtidaiyah. *Indonesian Journal of Innovation Studies*, *21*, 10–21070.

Arliani, S. P., & Khabibah, S. (2022). Development of Mathematical Digital Comics With Ethnomathematics Approach To Class Iii Elementary School on Weight Unit Conversion Material. *MATHEdunesa*, *11*(2), 481-487.

Astiti, N. D., Mahadewi, L. P. P., & Suarjana, I. M. (2021). Faktor Yang Mempengaruhi Hasil Belajar IPA. *Mimbar Ilmu*, *26*(2), 193. https://doi.org/10.23887/mi.v26i2.35688

Branch, R. M. (2009). *Instructional design: The ADDIE approach* (Vol. 722). Springer.

Buchori, A., & Murtianto, Y. H. (2017). Pengembangan comic math dengan pendekatan etnomatematika pada meteri kubus dan balok di smp. *Aksioma: Jurnal Matematika dan Pendidikan Matematika UPGRIS Semarang*, *8*(1), 31-40.

Burhannudin Milama, Safinah Adiliyah, D. F. (2023). Development Of E-Boolet Based On Problem-Based Learning On Acid Base Material For Problem-Solving Ability. *Edusains*, *15*(May), 86–98. https://doi.org/http://dx.doi.org/10.15408/es.v13i2.18883

Cahyadi, A. (2019). Pengembangan Media dan Sumber Belajar: Teori dan Prosedur. In *Laksita Indonesia*. https://idr.uin-antasari.ac.id/16140/

Cahyono, B., Rohman, A. A., & Setyawati, R. D. (2023). Pengembangan Media Pembelajaran E-komik Berbasis Etnomatematik dan Kemampuan Berpikir Kreatif pada Materi Geometri MTs. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(2), 2283-2295.

Chung, B. S., Park, E., Kim, S.-H., Cho, S., & Chung, M. S. (2016). Comic Strips to Accompany Science Museum Exhibits. *Journal of Education and Learning*. *5*(4): 141. https://doi.org/10.5539/jel.v5n4p141

Damasanti, L., & Nuroh, E. Z. (2023). Penggunaan Media Powerpoint Pada Pembelajaran Tematik di SD Muhammadiyah 1 Krian. *Jurnal Dimensi Pendidikan Dan Pembelajaran*, *11*(1), 19–25.

Fathani, A. H. (2016). Rahmah Johar. "Domain Soal PISA untuk Literasi matematikaa". *Jurnal EduSains*, *4*(2), 136–150.

Fitrianingsih, Y., Suhendri, H., & Astriani, M. M. (2019). Pengembangan Media Pembelajaran Komik Matematika Bagi Peserta Didik Kelas VII SMP / MTS Berbasis Budaya. *Jurnal PETIK*. *5*(2): 36–42.

Hanik, U., & Nurtamam, M. E. (2017). Integrasi Etnomatematika Dalam Pembelajaran Matematika Sekolah

Dasar. *Seminar Nasional PGSD UNIKAMA*, *1*, 482–488. https://doi.org/https://doi.org/10.31219/osf.io/724b6

Indrawati, F. (2023). Matematika dalam Menghadapi Tantangan Abad Ke-21. *Original Ressearch*, *80*, 411–418.

Kerneža, M., & Košir, K. (2016). Comics as a literary-didactic method and their use for reducing gender differences in reading literacy at the primary level of education. *Center for Educational Policy Studies Journal*. *6*(2): 125–149.

Mikamahuly, A., Fadieny, N., & Safriana, S. (2023). Analisis Pengembangan Media Komik Pembelajaran untuk Meningkatkan Minat Belajar Peserta Didik. *Jurnal Pendidikan Dan Ilmu Fisika*, *3*(2), 256–263.

Muhid, A. (2019). Analisis Statistik SPSS. In *Zifatama Jawara*. http://repository.uinsa.ac.id/id/eprint/1047/

McLaughlin, R., & Bell, R. (2002). Connecting Through Comics: Expanding Opportunities for Teaching and Learning. *Emergency Medicine Journal*. *19*(4): 375–376. https://doi.org/10.1136/emj.19.4.375-b

Nesri, F. D. P. (2020). *Pengembangan modul ajar cetak dan elektronik materi lingkaran untuk meningkatkan kecakapan abad 21 siswa kelas XI SMA Marsudirini Muntilan*. Universitas Sanata Dharma.

Nida, I. K., Buchori, A., & Murtianto, Y. H. (2017). Pengembangan Comic Math Dengan Pendekatan Etnomatematika Pada Meteri Kubus Dan Balok Di Smp. *Aksioma*. *8*(1): 31. https://doi.org/10.26877/aks.v8i1.1531

Nugraheni, N. (2017). Penerapan Media Komik Pada Pembelajaran Matematika Di Sekolah Dasar. *Refleksi Edukatika : Jurnal Ilmiah Kependidikan*, *7*(2), 111–117. https://doi.org/10.24176/re.v7i2.1587

Nugroho, S. (2023). Komik Digital Sebagai Media Pembelajaran Bahasa Jawa Submateri Kisah Ramayana. *Jurnal Dimensi Seni Rupa Dan Desain*, *20*(1), 43–60. https://doi.org/10.25105/dim.v20i1.5395

Nurdyansyah. (2019). Media Pembelajaran Inovatif. In P. Rais (Ed.), *Sustainability (Switzerland)* (Vol. 11, Issue 1). UMSIDA Press. http://scioteca.caf.com/bitstream/handle/123456789/1091/RED2017-Eng-8ene.pdf?sequence=12&isAllowed=y%0Ahttp://dx.doi.org/10.1016/j.regsciurbeco.2008.06.005%0Ahttps://www.researchgate.net/publication/305320484_sistem_pembetungan_terpusat_strategi_melestari

Putro, P. C., & Setyadi, D. (2022). Pengembangan Komik Petualangan Zahlen Sebagai Media Pembelajaran Matematika Pada Materi Bangun Ruang Sisi Datar. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(1), 131–142. https://doi.org/10.31980/mosharafa.v11i1.693

Rahayu, R., Iskandar, S., & Abidin, Y. (2022). Inovasi Pembelajaran Abad 21 dan Penerapannya di Indonesia. *Jurnal Basicedu*, *6*(2), 2099–2104. https://doi.org/10.31004/basicedu.v6i2.2082

Ritonga, S. Y. and M. (2023). *Seminar Nasional Matematika, Jurusan Matematika* (Issue November).

Shomad, M. A., & Rahayu, S. (2022). Efektivitas Komik Sebagai Media Pembelajaran Matematika. *Journal Of Technology Mathematics And Social Science)*, *2*(2), 2829–3363.

Subroto, E. N., Qohar, A., & Dwiyana, D. (2020). Efektivitas Pemanfaatan Komik sebagai Media Pembelajaran Matematika. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *5*(2), 135. https://doi.org/10.17977/jptpp.v5i2.13156

Sugiyono, D. (2013). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif dan R&D*.

Suherman, E. (2003). *Strategi pembelajaran matematika kontemporer*. Bandung: Universitas Pendidikan Indonesia.

Supriadi, G. (2021). *Statistik penelitian pendidikan*. UNY press.

Wati, N. P. E. P. (2022). Model Problem Based Learning Berbantuan Media Komik Solusi Meningkatkan Kompetensi Pengetahuan Matematika Siswa Kelas V SD. *Mimbar Pendidikan Indonesia*, *3*(3).

Wahid, A., Handayanto, A., & Purwosetiyono, F. X. D. (2020). Pengembangan Media Pembelajaran Berbasis Etnomatematika Menara Kudus Menggunakan Adobe Flash Professional CS 6 pada Siswa Kelas VIII. *Jurnal Matematika Dan Pendidikan Matematika*. 2(1): 58–70. http://journal.upgris.ac.id/index.php/imajiner/article/download/5765/3075

Winaryati, E., Munsarif, M., & Mardiana. (2021). *Cercular Model of RD&D (Model RD&D Pendidikan dan Sosial)*.

Widyawati, A., & Wijayanti, A. (2019). Pengaruh Media Komik Sains Berbasis Karakter Terhadap Minat Baca Dan Hasil Belajar Mahasiswa Pendidikan Ipa. *Sosiohumaniora*. *5*(1): 66–77. http://jurnal.ustjogja.ac.id/index.php/sosio/article.view/3075