

INTEGRATION OF MALANGAN MASK PUPPET ETHNOMATHEMATICS IN E-COMICS TO IMPROVE ALGEBRA LITERACY SKILLS OF VIII GRADE STUDENTS ON THE CONCEPT OF SETS

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ABSTRACT

The purpose of this study is to develop learning media in the form of an e-comic based on the ethnomathematics of the Malangan Masked Wayang to improve algebraic literacy, especially in the material of set theory. The main problem underlying this study is the low ability of students to abstract mathematical concepts from real contexts into algebraic symbols. Ethnomathematics in this study is through the classification of Malangan Masked Wayang characters based on mask colors, character traits, and clothing attributes. Explicitly, these cultural elements are constructed into set theory concepts, including universal sets, subsets, and set operations (intersections and unions). The research method used is R&D with the ADDIE model to describe the validity, effectiveness, and practicality of the development product. The effectiveness test procedure uses a *Paired Sample t-test* with a significance level of 5%. The results obtained on average on the e-comic validation score are 94% which means the data is very valid. In terms of practicality, the e-comic product based on the ethnomathematics of the Malangan Masked Wayang has an average of 93.3%, including the very practical category. Then the effectiveness value of e-comics was found to have a fairly large score on the N-gain value, namely 0.64. These results can be concluded that e-comics based on ethnomathematics of Malangan mask puppets have good validity, are very practical, and are quite effective in improving the algebraic literacy of MTs grade VIII students.

Keywords: E-comics, Ethnomathematics, Algebraic Literacy

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PRELIMINARY

The development of mathematics and technology was marked when human civilization entered the 21st century. This development has an impact on various aspects of society. According to Miller (2018), the development of knowledge in education should create human resources (HR) with the ability to face various challenges in life. Nursyamsudin and Jaelani (2021) explain that in the 21st century, education refers to a process that enables students to create solutions for various problems related to the environment, the era of globalization, technological advancements, and the impact of

mathematical technology. Polat and Turhan (2022) add that with the ability to read and learn mathematics, students can create knowledge to face challenges in the 21st century. Someone with reading or literacy skills in mathematics will become accustomed to thinking critically and can utilize their knowledge to solve problems in their surroundings.

OECD (*Organisation for Economic and Development*) (2022) explains mathematical literacy as the ability to apply mathematical knowledge in the real world. Habibi and Suparman (2020) emphasize that mathematical literacy is essential for students, as mathematical literacy is needed in the 21st century. 21st-century skills make mathematical literacy, particularly algebra literacy, an indicator that students must master problem-solving (Guinocor et al., 2020). Algebra literacy indicators include three aspects (Rusmining et al., 2019). First, formulate the existing issue mathematically. Second, using concepts, facts, procedures, and reasoning. Third, interpret and apply it, and then evaluate the results of the mathematical process. Utomo (2022) states that one way to face various challenges of the 21st century is through algebraic literacy.

Algebra literacy is an important part of mathematical literacy that includes understanding, interpreting, and using algebraic concepts and symbols in problem-solving, which students need to grasp (Putri, 2021). Algebra literacy is the ability to calculate or solve problems and includes critical thinking skills in connecting algebra concepts with real-life situations (Ojo et al., 2020). Algebraic literacy is important because algebra is the foundation of various more complex branches of mathematics, such as geometry, calculus, and statistics. In addition, understanding algebra is necessary in various aspects of life, for example, to understand data, make predictions, or solve practical problems involving variables (Hwang & Ham, 2021).

Previous research on algebra literacy has been conducted by (Angriani, 2020; Kholifasari, 2020; Rusmining, 2019; Toh, 2009). The research conducted by Angriani (2020) explains algebra literacy as part of understanding mathematics that focuses on the content of change and relationships with algebraic elements as its specification. Rusmining (2019) research found that students have difficulty understanding the concept of (change and relationships) related to simplifying algebraic forms. Then, research conducted by Toh (2009) shows the mistakes students often make when performing arithmetic operations, the difficulties in understanding algebraic concepts, and interpreting unknown symbols. Furthermore, Kholifasari's (2020) research states that students experience difficulties in algebra literacy in using formulas and rules in algebraic operations and cannot provide the correct steps when solving problems.

Students' low algebra literacy skills are due to several factors, namely the abstract approach to learning. Students often feel that algebra learning is too theoretical and difficult to relate to everyday life contexts (Adawiyah, 2023). Every lesson lacks literacy presentation, such as learning resources with the PISA framework (Stacey & Turner, 2015). The limited media used for learning, which tends to be monotonous, makes students less motivated to learn mathematics (Susanta, 2023). Not only is it low, but the mathematical literacy skills of Indonesian students have also declined, as shown by the assessment results conducted by the Programme for International Student Assessment (PISA). Indonesian students in the 2022 PISA study recorded a score drop of 366, compared to the OECD country average score of 489 (OECD, 2022).

The proof of students' low algebra literacy is reinforced by the research results of Yazon (2020), which explain that the cause is students being too lazy to read and comprehend the questions. Students also have difficulty solving problems because most of the questions are far from real life, and they are still not accustomed to solving problems using mathematical learning standards. The standard process of mathematics learning is fundamentally capable of helping students improve their ability to solve the given problems.

This research focuses on using social contexts related to daily life to support algebra literacy through an ethnomathematics approach. The ethnomathematics approach connects mathematics learning with culture to make the learning more relevant (Shannon, 2021). The ethnomathematics concept mentioned is the culture of Malangan mask puppetry. Widiyanto (2018) explains that there are 76 wayang characters, which are then classified into good characters (protagonists), bad characters (antagonists), supporting characters, and animal characters. Wayang topeng Malangan is presented through dance movements, and the puppeteer delivers the dialogue. Through the ethnomathematics of Malangan mask puppetry, students can integrate algebraic elements into set theory material obtained from classifying its characters.

In line with Wardono (2016), the ethnomathematics of Malangan mask puppets and algebraic literacy are related as facilitators for implementing realistic innovative learning. Utomo (2022) stated that students' algebraic literacy skills can be improved, namely through the presentation of mathematical teaching media. Adawiyah (2023) argues that one of the obstacles to learning algebra material is the inaccuracy in selecting learning media. Learning media must be made interesting and related to real life so that it is in accordance with the objectives so that students do not feel lazy due to a lack of motivation in teaching

and learning activities (Choirudin, 2021; Chusniah & Setianingsih, 2021; Luthfi & Rakhmawati, 2022). This study focuses on the characteristics of Malangan Mask Wayang characters based on color, nature, and role in abstraction of set theory to build students' algebraic literacy skills through digital learning media. The development of digital media in the form of e-comics that combine visual narratives, folk tales (Panji plays), and digital interactions is more relevant to learning styles in the 21st century.

Although ethnomathematics research on Wayang Topeng has been widely conducted, most are still limited to aspects of geometry and shape classification. Therefore, the novelty of this research is through the use of wayang Topeng Malangan as a medium for developing algebraic literacy, especially in the material of set theory. This research is present to integrate the visual narrative of e-comics with the logical structure of sets in Malangan culture. In addition, this approach can help students understand algebra in the material of sets for contexts close to the surrounding environment, while simultaneously improving students' abilities in reading, writing, and using mathematical symbols with more confidence and meaning.

METHODS

This research methodology uses (R&D) or research and development using the ADDIE model. ADDIE development consists of five stages: analysis, design, development, implementation, and evaluation. The research was conducted at MTs Nurul Huda Babadan, Ngajum District, Malang Regency to conduct an e-comic trial based on Malangan mask puppet ethnomathematics. The trial was carried out in March of the even semester of the 2023/2024 academic year in class VIII A and class VIII B with a total of 40 research subjects. The selection of the trial location was based on information provided by the mathematics teacher at MTs Nurul Huda who stated that the algebra literacy of class VIII students needed to be improved.

Data collection techniques in this study used observation, interviews, and tests. The research instruments include e-comic validation sheets and test sheets. The validity of e-comic products involves five expert examiners: material experts, learning experts, media experts, technology experts, and language experts. The assessment results are then categorized based on the validity, practicality and effectiveness category tables. The formula used to analyze the product validity test is

$$P = \frac{\sum x}{N} \times 100\% \quad (1)$$

Description : P = percentage
 $\sum x$ = number of scores obtained by each validator
 N = number of question items

The range of media validity intervals is based on a certain interval distance and is arranged in a table to determine the level of data analysis criteria (Sugiyono, 2017). The validity criteria for the media resulting from the development are listed in Table 1.

Table 1. Media Validity Criteria

| Presentation | Product Quality | Decision |
|------------------------|-------------------------------|--|
| $85\% < NA \leq 100\%$ | Very appropriate/very valid | The product is ready-used |
| $70\% < NA \leq 85\%$ | Appropriate/Valid | The product is ready-used |
| $55\% < NA \leq 70\%$ | Quite appropriate/Quite valid | The product can be used with the revision. |
| $40\% < NA \leq 55\%$ | Less appropriate/less valid | The product still needs to be revised. |
| $0\% < NA \leq 40\%$ | Inappropriate/invalid | The product does not match/failed. |

Source: (Sugiyono, 2017)

Furthermore, after obtaining expert validation, the product is given to practitioners, namely mathematics subject teachers. Practitioner experts have an important role in providing input to ensure that the media developed is by curriculum standards, academically accurate and relevant to students' learning needs. The range of media practicality values is shown in Table 2.

Table 2. Media Practicality Value Range

| Average (\bar{x}) | Classification |
|-------------------------|----------------|
| $85 \leq \bar{x} < 100$ | Very Practical |
| $70 \leq \bar{x} < 85$ | Practical |
| $50 \leq \bar{x} < 70$ | Less Practical |
| $0,0 \leq \bar{x} < 50$ | Not Practical |

Source: (Sugiyono, 2017)

The effectiveness test of e-comic media is based on data analysis on algebraic literacy skills. Students before and after treatment. A test was conducted based on algebraic literacy indicators to measure students' algebraic literacy skills. The following are indicators of students' algebraic literacy skills (Angriani et al., 2020) shown in Table 3.

Table 3. Algebra Literacy Indicators

| Algebraic Literacy Indicators | Criteria |
|---|--|
| 1. Identify and formulate algebraic situations (formulate) | <ol style="list-style-type: none"> 1. Expressing everyday problems in the form of sets and listing their members. 2. Mentioning elements that are included in the members of a set and those that are not members of a set. |
| 2. Employing algebraic concepts, facts, procedures, and reasoning (apply) | <ol style="list-style-type: none"> 1. Presenting sets with set-forming notation. 2. Draw a Venn diagram that illustrates the relationships between sets. 3. Understand the basic concepts of sets, including subsets, intersections, and unions. |
| 3. Interpret, apply, and evaluate algebraic results (evaluate) | <ol style="list-style-type: none"> 1. Reinterpret the results of problem-solving in a real context related to sets. 2. Apply the correct use of sets to state the membership of an element in a set with the correct notation. 3. Evaluate the results of solving the concept of sets for problems relevant to everyday situations. |

Source (Angriani et al., 2020)

Effectiveness test before and after treatment using paired Sample t-test and to find out how much the increase in student literacy is using the N-gain test. The effectiveness test of e-comics on students' algebraic literacy skills is based on class VIII. Data processing using N-gain with a significance level of 5%. The N-gain category is shown in Table 4.

Table 4. N-Gain Value Category

| N-gain Value | Category |
|---------------------|-----------------|
| $N > 0,7$ | Tall |
| $0,3 > N < 0,7$ | Currently |
| $N < 0,3$ | Low |

Source (Riduwan, 2016)

RESULT AND DISCUSSION

This research produces a learning media product in the form of an interactive e-comic. Based on ethnomathematics of Malangan mask puppets to improve students' algebraic literacy skills on set material. The development of this e-comic uses the ADDIE development model, which consists of five stages: analysis, design, development, implementation, and evaluation. The following is a description of the research results obtained from each stage.

1. Analysis

The analysis stage consists of observations and interviews to obtain information data in the field. The observation was conducted in class VIII MTs Nurul Huda Babadan, Ngajum District, Malang Regency. The analysis results consisted of three steps: preliminary study, field study analysis, and needs analysis. In the preliminary study analysis stage, the researcher conducted a question-and-answer session with the mathematics subject teacher of MTs Nurul Huda. The results showed that the process of delivering mathematics material used by the teacher was conventional, relying on lecture methods and student textbooks. In addition, there was information that class VIII students had difficulty understanding the material on sets. They had difficulty accepting the material on sets because the concept of sets was quite abstract for students, and they had difficulty understanding the notation or symbols of sets. No learning media was used to support the process of delivering the material, so teachers did not yet know that the material on sets could be related to everyday life.

After carrying out the preliminary study analysis, the next step is to analyze the field study through initial observation by asking questions related to algebraic literacy on the set material. From the work process results, it is known that students have difficulty working on questions because their literacy skills are still lacking, and they are confused about correctly naming sets. The next stage is the needs analysis stage. Then, the needs regarding media that are suitable for MTs level students will be identified, and the problems that have been observed will be adjusted. The information collection was carried out by asking MTs Nurul Huda mathematics teachers about the facilities students needed during the learning process. It was found that MTs Nurul Huda uses an independent curriculum, which means the scope of material on algebraic elements mathematics learning outcomes in grade VIII, namely sets. In addition, the teaching materials used by students are only printed books. Students are not allowed to use cell phones while at school but are allowed to bring laptops to support learning materials. The school also provides a multimedia lab and smart TV, but the mathematics teacher there has never used these facilities.

From the analysis, the researcher evaluated that there needs to be a breakthrough to support the student learning process by creating a learning media by utilizing existing school facilities. The learning media is in the form of interactive learning media that can be accessed digitally. One example is developing digital comics or mathematical e-comics. Ecomics are developed by highlighting the typical arts of Malang Regency, namely

Malangan mask puppets, as an approach to the set material. Thus, the e-comic learning media based on Malangan mask puppet ethnomathematics is expected to increase students' interest in reading and be able to improve the algebraic literacy skills of grade VIII students in the set material.

2. Design

This stage is carried out by compiling or creating e-comic products from valid collection materials that are practical, effective, and easy to understand. It also includes indicators of algebraic literacy. Making The comic itself is composed of four steps, namely: determining the field of study to be used, compiling e-comic materials, designing e-comic designs, and programming e-comics. In the first step, the researcher determines the set material as a study that is used as the focus in developing e-comic media. The determination of the study discusses the set because it departs from an approach related to the culture or ethnomathematics of Malangan mask puppets, which consist of several character figures with their own characteristics and traits. The development of e-comics is based on the mapping of related Learning Outcomes (CP) and also based on the characteristics of the product being developed. The design of the e-comic content begins with the creation of the title cover. The title cover contains the agency logo accompanied by a cartoon of the mask puppet actor. Furthermore, the design contains a menu home (opening page) containing instructions, CP&TP, cultural introduction, e-comic material, in-depth material, formative tests, and product developer profiles.

The second step is to compile e-comic material using a prototype because it allows users to test concepts and get feedback before full production begins. Prototype: The media is divided into three largest parts. The first part is the introduction of comic characters, namely Mrs. Teacher (a beautiful, patient, firm, and disciplined character), Kiki (a cheerful, active, smart character), and Farel (Kiki's classmate with a friendly, active, smart character). The second part is the adventure of Mrs. Teacher, Kiki and Farel visiting the mask puppet museum located in Kedungmonggo Village, Malang Regency. They went around the museum and recorded important information. When visiting the museum, there was an exhibition of puppet characters accompanied by an explanation of the character of each character. After visiting the exhibition, they continued their journey to watch the Malangan mask puppet performance, and then they remembered the discussion of the set material at school. Next, they discussed the set material that could be related to the Malangan mask puppet. Finally, after the explanation of the material with illustrations using puppet characters, Kiki and Farel were happy because they gained insight into

mathematical knowledge by enjoying the mask puppet museum; they learned and had fun together.

The third step is to design the e-comic design. At this stage, the researcher makes a chart of the overall design of the digital comic application flow. Flow charts serve to facilitate the creation of media so that each stage is carried out efficiently by producing quality products. The last step is programming e-comics. Researchers prepare components or programs for developing digital comics. The components in question are software (software) used as a tool for making e-comics. The first stage is through making a title cover using simple equipment such as paper, pencils, and erasers. After making a simple sketch, the next stage of colouring is done using the application Photoshop. Application usage: Photoshop is also used to colour the comic. Then, create a layout and design of the comic page equipped with various elements such as images, icons, shapes, and text to make it more attractive and easy for users to use. Then, the image can be applied to an animation that can move (interactive) with the application Adobe Animate. To use this application, there is a menu layering that allows developers to work with various graphic elements separately; coding facilitates the editing and revision process without damaging other elements of the comic.

This ethnomathematics-based e-comic also uses Adobe AI, which is required to change text to voice. Next, multilingual dubbing, which supports multiple languages and allows e-comics to be various natural-sounding voice languages, is used. Dubbing AI-generated content not only saves time and money but also allows creators to explore new creative possibilities in storytelling through voice.

3. Development

The initial development process begins with the creation of a home page according to the storyline that has been created at the design stage. The content developed in the e-comic is in the form of interactive media that automatically loads buttons as follows: opening page, title(cover), and home menu (instructions, cultural introduction, materials, material deepening, formative tests, and developer profiles). The e-comic cover design includes an illustration of a person wearing a mask, which is relevant to the e-comic approach that uses the Malangan mask puppet culture. The cover was edited using the Photoshop application and is shown in Figure 1.



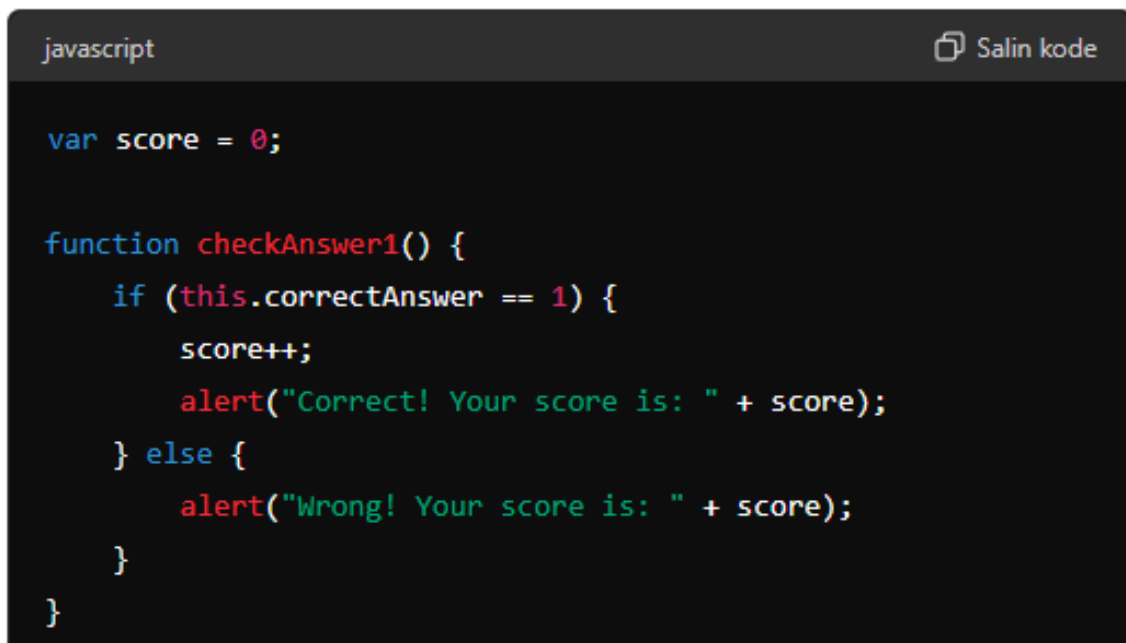
Figure 1. Edit images using Photoshop

Next, all the data and materials are collected and entered into Adobe Animate software. Here is the process of arranging the material, creating buttons, and inserting media elements such as audio, video, and animation. To combine all these elements, use Adobe Animate. For the animation, use classic tween on each object. The creation of e-comic materials goes through stages per frame, so every frame made one page on the learning media. The total frame is 56, with animation creation using action script 3.0, which is already available on Adobe Animate CC 2017. The view of Adobe AnimateCC 2017 is shown in Figure 2.



Figure 1. Adobe Animate View CC 2017

Coding is required to create quizzes or formative tests on Adobe Animate, especially to add functionality and interactivity. Adobe Animate allows the use of ActionScript(for SWF/Flash format) to control various aspects of animation and interactivity. The following is the coding in the e-comic creation process shown in Figure 3.

A screenshot of a code editor window titled 'javascript' with a 'Salin kode' button in the top right corner. The code is written in a dark theme with syntax highlighting. It defines a variable 'score' and a function 'checkAnswer1()' that checks if an answer is correct and updates the score and displays a message.

```
javascript Salin kode  
  
var score = 0;  
  
function checkAnswer1() {  
    if (this.correctAnswer == 1) {  
        score++;  
        alert("Correct! Your score is: " + score);  
    } else {  
        alert("Wrong! Your score is: " + score);  
    }  
}
```

Figure 2. Navigation Coding View

The product display on the menu "home" is the main page that functions as a navigation tool for users to access various features presented in e-comics. The "home" menu contains six items that can be accessed, namely instructions, CP&TP, cultural introduction, e-comics, in-depth material, formative tests, and developer profiles. The "home" menu is shown in Figure 4.



Figure 3. Home Menu Display

The e-comic material is related to the discussion of the ethnomathematics-based set of Malangan mask puppets. The ethnomathematics e-comic prologue introduces the explanation of Malangan mask puppets through a conversation played by Bu Guru, Kiki, and Farel. Malangan mask puppets have several characters that can be grouped based on their characteristics. The grouping of puppet characters is shown in Figure 5.



Figure 4. Display of Masked Wayang Character Grouping

After grouping characters, the next step is entering the material on sets, namely how to express sets in three ways, including enumeration, description, and formative

notation collection. The story in the e-comic is arranged with an interesting plot and is relevant to everyday life and the culture of Malangan mask puppetry. One display of the collection material is shown in Figure 6.



Figure 5. Display of Set Presentation Material

From the results of the development process, the product is then validated by material experts, learning experts, language experts, technology experts, and media experts. The following is a table of material expert validation results shown in Table 4.

Table 5. Validation Value Result

| Expert Validation | Score | Percentage |
|---------------------------|-------|-------------------|
| Subject Matter Expert | 3,38 | 84,38% |
| Learning Expert | 3,5 | 87,5% |
| Linguist | 3,12 | 78,12% |
| Media Expert | 3,8 | 96,8% |
| Technology Expert | 4 | 100% |
| Average percentage | | 94% |
| Scoring criteria | | Very Valid |

The results of the five validators obtained an average of 94%, which is included in the very valid category. This is in line with the opinion of Hobri et al. (2021) that comics are said to be valid if the score from the validator is between 81% and 100%. At this stage, the e-comic based on the ethnomathematics of the Malangan mask puppet is said to be very valid, but the e-comic still received notes from the validators that needed to be revised

because there were still typing errors, and the editorial had to be replaced with sentences that were easier to understand.

4. Implementation

The trial phase has the aim of measuring practicality in learning. The subjects of the test This development is 40 students of class VIII MTs Nurul Huda Babadan, Ngajum District. Learning is carried out in two meetings. During learning, students show high enthusiasm in discussing. In addition, they fill out formative tests in comics and fill in the blanks in the question and answer session, and the classroom atmosphere becomes more enjoyable. E-comics are also very easy for students to access because the application can still be accessed even if it is not connected to the internet.

Implementation data was obtained through two observers during the teaching and learning activities. The results of the implementation of learning are as follows.

Table 6. Practicality Value Result

| Meeting | Observer 1 | Observer 2 | Average |
|-----------------------------|------------|------------|-----------------------|
| 1 | 85% | 93,3% | 92% |
| 2 | 86% | 95% | 93% |
| Average Practicality | | | 93,3% |
| Scoring Criteria | | | Very Practical |

The average practicality score from both observers was 93.3% and was included in the category of very practical. The practicality of e-comics based on Malangan mask puppet ethnomathematics is in line with Budi's opinion (2023), which states that the practicality of e-comics is at least 81% so that it can be used in learning.

5. Evaluation

This evaluation stage is divided into two parts, namely, formative evaluation. Formative evaluation is carried out at each stage of development, and at the final stage, e-comic products based on Malangan mask puppet ethnomathematics are implemented to determine the effectiveness of the development product. The effectiveness of this e-comic is measured through student test results in the form of pre-test and post-test, which aims to improve students' algebraic literacy. In the analysis of the results of students' algebra literacy, there are differences in students' average scores, as can be seen in Table 7 below.

Table 7. Results Pre-test and Post-test

| Data | Class VIII | |
|--------------------|-----------------|------------------|
| | <i>Pre-test</i> | <i>Post-test</i> |
| Number of Students | 20 | 20 |
| Lowest Value | 25 | 63 |
| The highest score | 88 | 100 |
| Average value | 63,6 | 84,3 |
| N-gain | 0,60 | |
| Criteria | Currently | |

The data in Table 7 above shows that before using e-comics, this ethnomathematics-based interactive shows the average value of pre-test students of 63.6. However, after using interactive e-comics in the learning process, the average score of post-test students became 84.3. This shows an increase in the effectiveness of algebraic literacy, which can be known using the N-gain formula. The results of the N-gain calculation are 0.64, which is included in the moderate criteria, and there is an increase in learning.

The increase in students' algebra literacy scores in this study proves that mathematical literacy is not only about calculating skills, but also contextualization skills. This finding is in line with Fitriyani's (2019) study which emphasized that the "Generational" phase in algebra involves the formation of expressions and equations from real-world situations. The use of Malangan Mask puppets, students train their translation skills from cultural phenomena into mathematical models of sets explicitly. In addition, the connection with culture develops an interesting learning media for students. Through the application of e-comics, students become active because e-comics are in an interactive form that has sections that need to be filled directly by students and include images and videos related to the material, so that students gain new activities and understanding in learning. During the use of e-comics, students become interested and have high enthusiasm because e-comics are new media being implemented for the first time. In addition, the interaction between teachers and students during the learning process in the classroom becomes active and learning is not only centered on the teacher. The learning process that is dominated by student activities leads to the achievement of algebraic literacy.

CONCLUSION

Based on the results of the development and trials, it can be concluded that the ethnomathematics-based e-comic of the Malangan Mask puppet is feasible and effective for improving students' algebraic literacy, particularly in set theory. Explicitly, the integration of character characteristics, such as mask color and character traits related to the definitions of sets, subsets, and intersection and union operations has been proven to improve students' algebraic literacy. The visual narrative in the e-comic is able to bridge abstract algebraic concepts with real local cultural contexts, thereby improving students' literacy reasoning abilities. Despite showing positive results, this study has limitations that need to be considered. The focus of algebraic literacy in this media is still limited to set theory, so it has not yet touched on other sub-chapters of algebra such as linear equations or functions. The effectiveness of using e-comics is highly dependent on the availability of digital devices and the stability of students' internet connections, which may vary from school to school. For further development, it is recommended for future researchers to develop similar media for more complex algebraic materials, such as relations and functions or systems of linear equations, while still emphasizing local wisdom. Adding game features to e-comics to improve student retention through independent learning. Conducting a longitudinal study to determine whether improving algebraic literacy through this ethnomathematics approach impacts student academic achievement at higher levels of education.

REFERENCES

- Adawiyah, N., Makki, M., & Nisa, K. (2023). Analisis Faktor Penyebab Rendahnya Kemampuan Numerasi Siswa. *Journal of Classroom Action Research*, 5(1), 239–244. <https://doi.org/10.29303/jcar.v5i1.2845>
- Angriani, V., Herman, T., & Nurlaelah, E. (2020). Algebraic literacy skills of secondary school students. *Journal of Physics: Conference Series*, 1657(1). <https://doi.org/10.1088/1742-6596/1657/1/012034>
- Chusniah, E. R., & Setianingsih, R. (2021). Pengembangan Komik Matematika Berbasis Kontekstual Untuk Materi Lingkaran. *Jurnal Penelitian Pendidikan Matematika Dan Sains*, 3(2), 55. <https://doi.org/10.26740/jppms.v3n2.p55-64>
- Guinocor, M., Almerino, P., Mamites, I., Lumayag, C., Villaganas, M. A., & Capuyan, M. (2020). Mathematics Performance of Students in a Philippine State University. *International Electronic Journal of Mathematics Education*, 15(3). <https://doi.org/10.29333/iejme/7859>
- Habibi, H., & Suparman, S. (2020). Literasi Matematika dalam Menyambut PISA 2021 Berdasarkan Kecakapan Abad 21. *JKPM (Jurnal Kajian Pendidikan Matematika)*, 6(1), 57. <https://doi.org/10.30998/jkpm.v6i1.8177>
- Hwang, J., & Ham, Y. (2021). Relationship between mathematical literacy and opportunity
-

- to learn with different types of mathematical tasks. *Journal on Mathematics Education*, 12(2), 199–222. <https://doi.org/10.22342/JME.12.2.13625.199-222>
- Indefenso, E. E., & Yazon, A. D. (2020). Numeracy Level, Mathematics Problem Skills, and Financial Literacy. *Universal Journal of Educational Research*, 8(10), 4393–4399. <https://doi.org/10.13189/ujer.2020.081005>
- Kholifasari, R., Utami, C., & Mariyam, M. (2020). Analisis Kemampuan Literasi Matematis Siswa Ditinjau Dari Karakter Kemandirian Belajar Materi Aljabar. *Jurnal Derivat: Jurnal Matematika Dan Pendidikan Matematika*, 7(2), 117–125. <https://doi.org/10.31316/j.derivat.v7i2.1057>
- Kuswari, R. I., & Choiruddin, C. (2021). The Development of Student Worksheet Based on Higher Order Thinking Skills in Improving Mathematics Learning Outcomes. *JMIE (Journal of Madrasah Ibtidaiyah Education)*, 5(2), 200. <https://doi.org/10.32934/jmie.v5i2.333>
- Luthfi, H., & Rakhmawati, F. (2022). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Etnomatematika pada Materi Bangun Ruang Sisi Lengkung Kelas IX. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(1), 98–109. <https://doi.org/10.31004/cendekia.v7i1.1877>
- Miller, T. (2018). Developing numeracy skills using interactive technology in a play-based learning environment. *International Journal of STEM Education*, 5(1). <https://doi.org/10.1186/s40594-018-0135-2>
- Nursyamsudin, & Jaelani, M. N. G. (2021). *Penguatan Literasi dan Numerasi* (p. 79).
- OECD. (2022). *PISA PISA 2022 Results*.
- Ojo, E. M., John, A., & Ayodele, O. O. (2020). Appraising the Efficacy of Mental Math Strategy on Acquisition of Numeracy Skills: A Case of Literacy Programme in South West, Nigeria. *Academia.Edu*, 7(April), 38–44. <https://www.academia.edu/download/63168068/IJRR00620200501-67652-u6v060.pdf>
- Polat M, & Turhan, N. S. (2022). A Meta-Analysis Study on the Relationship Between Mathematical Literacy and Mathematics. *International Online Journal of Education and Teaching*, 9, 661–676.
- Putri, B. A., Utomo, D. P., & Zukhrufurrohmah, Z. (2021). Analisis Kemampuan Literasi Numerasi Peserta Didik SMP dalam Menyelesaikan Soal Cerita Aljabar. *JRPM (Jurnal Review Pembelajaran Matematika)*, 6(2), 141–153. <https://doi.org/10.15642/jrpm.2021.6.2.141-153>
- Riduwan. (2016). *Skala Pengukuran Variabel-Variabel Penelitian* (P. Dwija Iswara (ed.); 3rd ed.). CV. Alfabeta.
- Rusmining, Purwanto, A., & Sumargiyani. (2019). Analysis of content components and context components of mathematics literacy on linear algebra. *Journal of Physics: Conference Series*, 1188(1). <https://doi.org/10.1088/1742-6596/1188/1/012003>
- Salafudin, Sholehuddin, M. S., Sholikhah, A., & Sari, N. H. M. (2022). Ethnomathematics in Elementary School Pengembangan LKS dengan Pembelajaran Matematika Realistik. *Jurnal Phenomenon*, 12(1), 77–89.
- Shannon, A. G. (2021). Ubiratan D’ambrosio [1932-2021] – ethnomathematics educator for the twenty-first century. *International Journal of Mathematical Education in Science and Technology*, 52(8), 1139–1142. <https://doi.org/10.1080/0020739x.2021.1948629>
- Stacey, K., & Turner, R. (2015). Assessing literacy mathematical the PISA experience. In *Springer Cham Heidelberg New York Dordrecht London*. <https://link.springer.com/book/10.1007/978-3-319-10121-7>
- Sugiyono, P. D. (2017). Metode penelitian bisnis: pendekatan kuantitatif, kualitatif,

- kombinasi, dan R&D. Penerbit CV. Alfabeta: Bandung, 225, 87.
- Susanta, A., Sumardi, H., Susanto, E., & Retnawati, H. (2023). Mathematics literacy task on number pattern using Bengkulu context for junior high school students. *Journal on Mathematics Education*, 14(1), 85–102. <https://doi.org/10.22342/JME.V14I1.PP85-102>
- Susetyo Widiyanto, A., Budiarjo, H., & Andrianto, N. (2018). Penciptaan Film 3d Animasi Pendek Tentang Karakter Topeng Malang Bergenre Adventure Dengan Teknik Stylized. In *Jurnal Layarupa: Film, Televisi dan Animasi* (Vol. 1, Issue 1).
- Toh, T. L. (2009). Use of Cartoons and Comics to Teach Algebra in Mathematics Classrooms. *National Institute of Education, Nanyang Technological University*, 230–239.
- Utomo, D. P., Sulfiah, S. K., & Inganah, S. (2022). *Literasi Aljabar di kalangan SMA berbasis Pesantren Siswa Sekolah*. 2, 247–260.
- Wardono, Waluya, S. B., M., S., & Candra, S. D. (2016). Mathematics Literacy on Problem-Based Learning with Indonesian Realistic Mathematics Education Approach Assisted E-Learning Edmodo. *Journal of Physics: Conference Series*, 693(1). <https://doi.org/10.1088/1742-6596/693/1/012014>
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