



# Development of Ethnomathematics-based Comics on Number Pattern Material

Fitri Nur Fakhriyah<sup>a,\*</sup>, Pika Merliza<sup>a</sup>

<sup>a</sup> *Departement of Mathematics, Metro State Islamic Institute, Jl. Ki Hajar Dewantara No. 15A, Iringmulyo, Metro Timur, Metro City, Lampung, 34112, Indonesia*

\* *E-mail address: fitrinurfakhriyah24@gmail.com*

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## Abstract

This study explains the steps in developing mathematical comics and the practicality of using comics in learning mathematics for junior high school students. The aim of this research is to create ethnomathematics-based comic learning media that focuses on number pattern material. The method in this research was the development method (Research and Development) with a 4D model (Define, Design, Develop, Disseminate). The research subjects were 28 class VIII junior high school students. Data collection techniques were carried out through interviews, observation, and questionnaires. The research results showed an average of 92.11% with a validity test score by material experts of 91.34%, while for media experts it was 95% and products that had been validated were then tested on students with results of 90%. Based on the assessment of instructional quality in trials with students, learning media was also stated to be in the very practical category, so that learning media can be used to help the mathematics learning process in schools.

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## 1. Introduction

Education is one way to improve the quality of human resources and is also considered a criterion in measuring the progress of a nation. Therefore, there are several countries that are trying hard to develop and improve the quality and quality of education in their countries (Asmaranti & Andayani, 2018). Educational explanations help people learn to think. The development of educational science and technology has enabled countries to develop (Sari et al., 2021), Education is very important to prepare human abilities that have high potential to be able to keep up with the times where there are developments in technology and science (Nursyeli & Puspitasari, 2021).

Mathematics is a very important field because it is the basis of many existing sciences and has applications in everyday life. Without mathematics a country would not be able to manage the universe proportionally and fairly. Many people think that mathematics is a difficult subject and not easy to master. This opinion becomes stronger when considering what students feel (Liberna, 2015). Mathematics is considered boring and difficult for students. One of the reasons female students cannot get good grades in mathematics learning is because teachers usually focus too much on solving problems that are more procedural in nature during the mathematics learning process (Sari et al., 2018). Mathematics is basically a method for solving problems, not a problem (Loviana et al. 2020).

The development of a smart country is influenced by education. Mathematics is a science that has the ability to improve human thinking patterns. Learning mathematics will teach students how to think logically, analytically, systematically, critically and creatively, as well as how to work together. Mathematics is a very important subject to pay attention to in the learning model so that it doesn't get boring (Basri et al. 2020). Mathematics is considered boring and difficult, but if studied in an interesting way, mathematics can be a fun subject related to everyday life.

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Because school math is a different kind of math from real-life math, students often find it useless (Apriadi, 2021). Therefore, to make students interested in learning, mathematics learning must have motivation. Through teaching mathematics, students' virtuous character will be instilled in them as the nation's next generation. In culture-based learning, creative learning is meaningful, fun and interesting (Wijayanto, 2017). Ethnomathematics is a science that studies mathematics in relation to culture found in everyday life (Risdiyanti & Prahmana, 2018).

Mathematics is a subject that provides cultural value involvement. With modernization and continuous technological progress, technological sophistication has eroded the existence of local wisdom values that already exist around us. This term later became ethnomathematics. D'Ambrosio first used the term "ethnomathematics" in 1997. Therefore, the term "ethnomathematics" is considered as a way to understand how mathematical concepts are linked to culture (Merliza, 2021).

One innovation in mathematics learning is culture-based learning. This method aims to eliminate the assumption that mathematics tends to be rigid (Pratiwi & Pujiastuti, 2020). Therefore, innovation is needed in mathematics learning from various parties who are in direct contact with culture (Nugraha & Novaliyosi, 2023). The philosophies, concepts, and actions of cultural groups are the subject of ethnomathematics research (Andriono, 2021). Ethnomathematics utilizes students' culture to produce better knowledge, skills and attitudes. This helps students' cognitive and emotional development (Fauzi & Setiawan 2020). To make students more interested in learning, interesting learning media is needed.

Learning media that can arouse interest and curiosity, arouse motivation and encourage learning activities, both educators and students can achieve success in the learning process in the classroom. Apart from the important role of teachers in the learning process, teachers are also required to develop and utilize learning media, one of which is innovation in the form of learning comics. In a learning process, the role of media is quite important to facilitate the learning process. To convey learning messages to students, teachers use visual aids in the form of pictures, models or other tools. This aims to provide concrete experience, motivation to learn, and increase learning absorption and references.

The use of appropriate learning media regarding the learning process can increase student learning motivation regarding the lessons that have been taught, students prefer to learn by using teaching materials that show visuals, non-standard language, and simple explanations of material. Students also tend to be more interested in reading picture books than textbooks, this is because picture books have a coherent storyline and are easy to remember. One learning media that can be used is comics (Mahendra et al., 2021). Now comics are starting to be used for learning, especially for children. This is due to the tendency of students not to like textbooks because they are not interesting. Even though students tend to prefer books with pictures, which are full of color and visualization in realistic or cartoon form. Learning comics are expected to increase students' interest in reading so that in the end they can improve student learning outcomes (Syahwela, 2020).

Based on the results of observations made by researchers at SMP Negeri 7 Metro, Metro City, Lampung Province in class VIII. From observations, researchers found that teachers lacked learning resources which resulted in students paying less attention to the teacher when explaining lesson material. The media used by teachers is textbooks. Limited learning media makes students lazy about studying because the learning system is less attractive to students resulting in low student learning outcomes. The results of interviews with mathematics subject teachers at SMP Negeri 7 Metro showed that students still had poor mathematics learning outcomes in number pattern material. For this reason, teachers need to use learning media that is interesting, motivating and helps students learn to make it more fun and easy to understand. The results of interviews with several class VIII students at SMP Negeri 7 Metro showed that in the learning process teachers had never used media such as comics.

Therefore, to help students overcome difficulties in solving mathematical problems by developing mathematics teaching materials related to ethnomathematics. Learning mathematics by connecting with the culture around us, such as the traditional game *congklak* originating from Central Java, includes material on even number patterns, while traditional games *MeJiKuHiBiNiU* and traditional house *Lengkong* which both come from Sundanese, contain material about various number patterns. Thus, the research aim is to develop Ethnomathematics-Based Comic learning media on Number Pattern Material.

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## 2. Methods

This research includes Research and Development (R&D) research which aims to develop this product. This research produces teaching materials in the form of comics based on ethnomathematics on number pattern material. This research uses a type of development (R&D) with the 4D model used: (1) defining

(defining) the objectives of this stage is the needs analysis stage (analyzing and collecting information). (2) design is the stage of designing teaching materials or learning media that will be developed. (3) developing (development) is realizing a predetermined design, or even completing a development product. (4) Dissemination, also called "spreading", is the stage of advancing a product that will be developed so that it can be used by consumers. In this research, trials were carried out at SMP Negeri 7 Metro class VIII D, totaling 28 students. The data collection tool is a questionnaire to measure product validity and practicality. Once the points are collected, the following formula is used to calculate the average expert rating:

$$Vsh = \frac{Tse}{Tsh} \times 100\%$$

Information with Vsh is expert validation, Tse is the total empirical points achieved, and Tsh is the total desired points. Table 1 shows the validity criteria after obtaining expert validation values.

**Table 1.** Validity Categories

Validity (V)	Criteria
$80\% < V \leq 100\%$	Very Valid
$60\% < V \leq 80\%$	Valid
$40\% < V \leq 60\%$	Quite Valid
$20\% < V \leq 40\%$	Invalid
$0\% < V \leq 20\%$	Very Invalid

Table 1 shows that the points in the questionnaire can be used to determine student responses. The average value of the obtained indicator points can be calculated and presented using the following method:

$$P = \frac{\Sigma f}{n} \times 100\%$$

Information :

P = Final Value

$\Sigma f$  = Number of Points

n = Maximum Points

V = Validity

Next, look for the average point of practicality. The principle of practicality can be obtained or seen through the following table.

**Table 2.** Product Practicality Criteria

Practicality (P)	Criteria
$80\% < P \leq 100\%$	Very practical
$60\% < P \leq 60\%$	Practical
$40\% < P \leq 40\%$	Quite Practical
$20\% < P \leq 30\%$	Less Practical
$0\% < P \leq 20\%$	Very Impractical

### 3. Results & Discussions

Researchers designed learning media in the form of comics using ethnomathematics-based number pattern material. The comic explains the relationship between culture and mathematics, for example in the comic, namely the traditional game *MeJiKuHiBiNiU*, the traditional game *congklak* and the traditional house *Lengkong*, through the development of a comic which is prepared using the following 4D development model.

### 3.1 Definition Stage (Define)

#### a. Front end analysis

This stage is carried out by collecting various types of information to find out the problems faced during learning activities and can develop mathematical comics, which help researchers to design appropriate solutions to solve these problems. Data was collected through interviews with mathematics teachers and students at SMP Negeri 7 Metro. Teachers have never used ethnomathematics-based mathematics comics in teaching. The application of teaching materials in the form of comic development is distributed directly to students in class. Apart from that, the information about learning using comics is also very interesting for students, there is an explanation of material about number patterns, the relationship between mathematics and culture and there are example questions and practice questions in it.

#### b. Student analysis

At this stage the researcher investigated the analysis of student characteristics, especially class VIII SMP Negeri 7 Metro. Characteristics: Class VIII students already have an understanding of number patterns when they are in class IV of elementary school. Thus, students' understanding is very necessary in studying number pattern material in class VIII because there will be more emphasis on various number patterns. Therefore, researchers designed the development of ethnomathematics-based mathematics comics to further motivate students to be more interesting in learning and getting to know culture. Indirectly, students already use existing mathematical knowledge in everyday life. One of them is the traditional game *MeJiKuHiBiNiU*, *congklak*, and traditional house *Lengkong* on number pattern material.

#### c. Task analysis

In task analysis activities, researchers analyze the tasks that have been carried out in developing comics for students to do. These tasks relate to Basic Competencies 3.3 (Understand and recognize odd, even, square, rectangular, Pascal's triangle number patterns. Based on local cultural ethnomathematics) and Basic Competencies 4.3 (Solving students' problems or difficulties in learning. Understanding and recognizing patterns of odd, even, square, rectangle, triangle, Pascal's triangle) mathematics lessons are mandatory for class VIII junior high school students and equivalent in the 2013 curriculum.

#### d. Concept analysis

The concept analysis stage can be carried out by researchers by analyzing the concepts needed by students. With the aim of identifying, measuring, detailing those concepts that are relevant to study. Results obtained from number pattern analysis.

#### e. Formulation of learning objectives

Based on the activities that the researcher has analyzed, after the activities have been evaluated the researcher creates learning objectives for mathematics comics.

### 3.2 Design Stage (Designing)

#### a. Preparation of Questionnaire Instruments

This stage begins with compiling a questionnaire grid that will be distributed to material expert validation, media expert validation and student response questionnaires.

#### b. Media Selection

In developing mathematical comics, researchers used Canva features which is easily accessed by students via the internet, teachers use technological tools such as smartphones, laptops and computers.

#### c. Format selection

In the process of developing this product, mathematical comics were used in a scientific approach format to relate traditional game culture *MeJiKuHiBiNiU*, *congklak* and traditional house *Lengkong* on number questions. The development of this comic uses a scientific approach that connects observation, asking questions and drawing conclusions about various number patterns.



**Figure 1.** Traditional house *Lengkong*



**Figure 2.** Traditional game *congklak*



**Figure 3.** Traditional game *MeJiKuHiBiNiU*

d. Initial design

At this stage the researcher created a comic design, designed data collection in the form of a validation sheet, and used Canva to create the comic. Initial comic design by designing and creating the front cover and pages using Canva. Comics are made using A4 paper size and use Times New Roman font. The comic developed by the researcher was made in two meetings, and directly discussed different material in these meetings. Ethnomathematics-based comic with material on number patterns at each meeting using a scientific approach. Comics that have been completed using Canva are then converted to PDF format and then printed for teaching materials to students. In the initial design of the first mathematics comic, the researcher consulted with the supervisor to obtain criticism and suggestions for necessary improvements to produce a mathematics comic that could be validated by experts.

### 3.3 Developing Stage (Development)

In the previous stage, produce mathematical comics in PDF form. After that, the pdf was given to two mathematicians, including the IAIN Metro mathematics lecturer as material expert validator one, the mathematics teacher at SMP Negeri 7 Metro as material expert validator two and IAIN Metro mathematics student alumni as media expert validators. Each expert validator is given a link in the form of a pdf for easy access.

**Table 3.** Validation Results and Practicality

No	Validated aspects	Percentage	Information
1	Material Aspects	91.34%	Very valid
2	Media Aspect	95%	Very valid
3	Student Affairs Aspects	90%	Very practical

Suggestions from validators regarding validation sheets from material experts and media experts include the following.

1. Proofread paragraphs and word writing. The previous post in the "hint at the person's name" step was corrected to "let's get to know each other". Examples of improvements can be seen as follows:



**Figure 4.** Improved word writing

2. Character improvement in comics. Based on the validator's suggestion, comic characters who previously wore trousers should be replaced by wearing skirts for those who wear the hijab and changing their hairstyle to make them look more attractive. An example of the improvement can be seen in Figure 5.
3. Improvement of the image of the traditional game *MeJiKuHiBiNiU*. According to the validator's suggestions, it can be clarified or enlarged. Example of a repair image in Figure 6.
4. Correct incorrect words or spelling. As per the validator's suggestions, there are incorrect words or spellings. Example of a repair image in Figure 7.



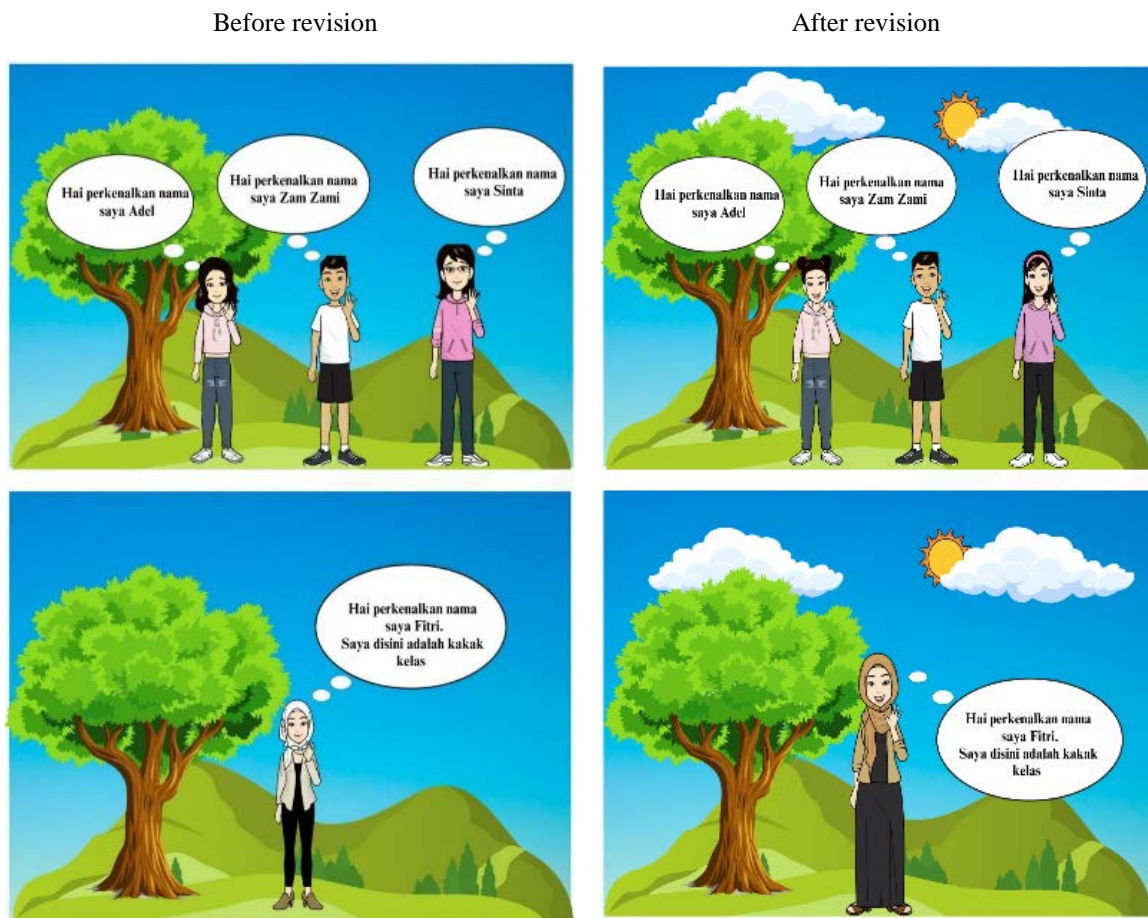


Figure 5. Character development in comics

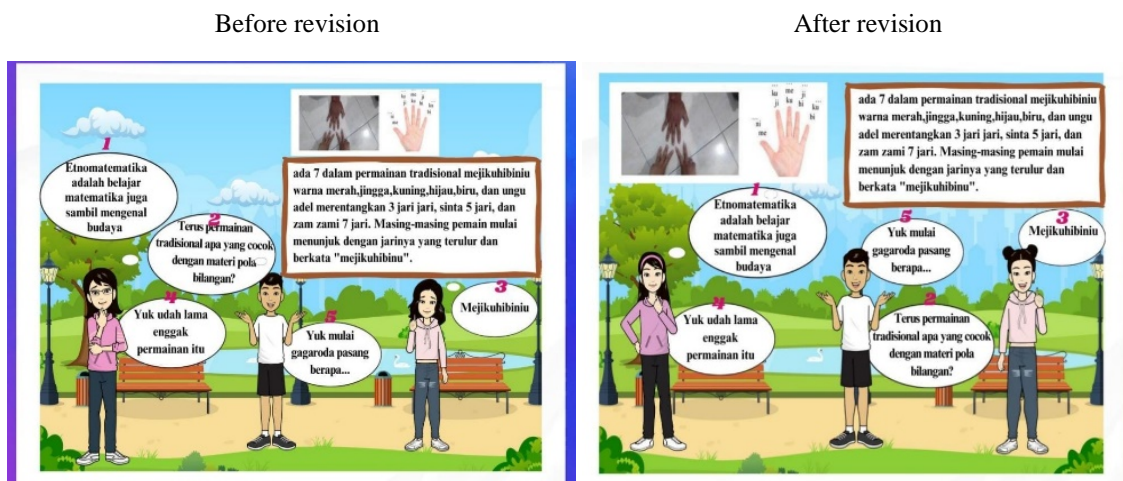


Figure 6. Improvements to the enlarged image of *MeJiKuHiBiNiU*



**Figure 7.** Correction of incorrect written words or images

### 3.4 Dissemination Stage Disseminate (Disseminate)

Research on the development of comic media was carried out on a small scale and was carried out on a limited basis with product trials during research at SMP Negeri 7 Metro with students and teachers. At the learning stage in school as teaching material, ethnomathematics-based number pattern material. Next, distribution is carried out by distributing comics to students in the class in groups. Teachers and students can also access comics on Google Drive which have been provided using technological tools such as cellphones, laptops, computers.



**Figure 8.** Research Documentation

## 4. Conclusion

Based on the results of the research and discussions that have been carried out, it can be concluded that the comic learning media developed is valid and practical for use in learning. This is in accordance with several questionnaire analysis results from material experts, media experts and students which state that comic learning media has good criteria. The practicality of this comic learning media is also supported by the average results in the good category, and the student learning response questionnaire is also in the good category.



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