



DEVELOPMENT OF PROBOLINGGO TRADITIONAL CULTURE ETHNOMATHEMATICS OF COMICS IN FLAT BUILDING GEOMETRY MATERIALS FOR STUDENTS

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Abstract:

The ability of students in learning geometry needs to be maximized in order to encourage increased logical thinking skills. Teachers in learning geometry are expected to use media that attract the attention of their students. One of the media that is expected to arouse students' learning motivation is comics. So this research will develop a prototype of comic media based on traditional cultural ethnomathematics in learning geometry. For this reason, the research and development (R&D) method was used with Plomp development as a research framework. Prototype I Comics were assessed by two validators and an art teacher who analyzed their readability. Based on the steps of the development method: the initial investigation, design, construction, and testing, evaluation and revision steps, a comic prototype of rectangular and triangular material with traditional cultural ethnomathematics nuances is obtained which meets validity and readability. The comics developed have not been implemented for MTs students in the school environment.

Keywords: *comic development, ethnomatics, local culture, flat shape geometry*

INTRODUCTION

Flat geometry is a branch of mathematics that studies the properties and dimensions of flat surfaces such as triangles, rectangles, circles, etc. This material is an important part of the education curriculum for elementary to secondary students. However, students often need help understanding the concept of geometry because it is abstract and lacks connection with everyday life.

Probolinggo traditional culture is one of Indonesia's cultural assets. These cultural values reflect the local community's perspective and knowledge of the world, including mathematics (Ufie, 2017). Ethnomathematics, as an approach to learning mathematics, invites exploring local wisdom in various aspects of people's lives and integrating it with learning mathematics.

Developing comics based on the ethnomathematics of traditional Probolinggo culture on geometric material for students is an innovative approach to teaching geometric shapes. In this case, ethnomathematics refers to the amalgamation of traditional Probolinggo culture, namely the cultural heritage and knowledge of local mathematics, with learning flat geometry.

Material associated with the local context, in this case, the culture in the student's environment, is known as ethnomathematics. Geometry and culture are intertwined, making school geometry closely related to the local environment and culture. This was emphasized by Sunzuma & Maharaj that the mathematics curriculum should be redesigned by incorporating an ethnomathematics approach. Indonesian researchers have widely discussed Ethnomathematics and the culture of the archipelago. The focus of the research included traditional villages, buildings, kebaya, and traditional crafts, all of which were concluded to have elements of mathematics, even though the perpetrators

did not necessarily study mathematics formally (Rahmata, 2021).

This study's novelty is an approach combining elements of traditional Probolinggo culture into learning flat geometry. This aims to establish a closer relationship between the subject matter and students' everyday lives, facilitating understanding and maintaining their interest in learning.

The goal is to develop comics based on ethnomathematics of traditional Probolinggo culture on geometric shapes that are expected to positively impact student learning, increase their understanding of subject matter, and appreciate local cultural diversity. In addition, this method can also be an attractive alternative to more conventional approaches to learning mathematics.

This research took place at MTs Uswatun Hashanah, which is the only Madrasah Tsanawiyah under the auspices of an Islamic boarding school located in Selogudg Wetan Village, Pajarakan District, Proboilinggo Regency. The institution has three classrooms with 25 students each, except for grade nine, which has 32 students. The curriculum used by the institution is the independent curriculum for grade 7, while grades 8 and 9 still use the 2013 curriculum.

This difference is a challenge for institutions with different curriculum concepts. In institutions/Madrasah Uswatun Hasanah in learning, just like institutions in general, the conditions of students are different. Some like all subjects; some only like certain subjects or vice versa, namely, hate on subjects. In several surveys conducted at MTs Uswatun Hasanah, mathematics was the subject students disliked the most. One of the contributing factors is the Priming effect.

The priming effect is a condition in which a stimulus or event affects a person's perception. For example, a student once heard his friends say that mathematics is difficult, complicated, and confusing. Unwittingly, these opinions can influence his perception to become a suggestion. What was normal at first, they can be carried away by their friends who do not like math (Chen et al., ... & Yang, 2019).

Culture-based comics have been developed, such as math comic learning media for students (Fitrianiingsih et al., 2019). Developing ethnomathematics-based learning media using the Kudus Tower using Adobe Flash Professional CS 6 for class VIII students (Wahid et al., 2020). Android-based comics with the RME approach using the 4D method (Latif et al., 2019). Developing E-Comic Media to Improve Students' Understanding of Mathematical Concepts (Afifah et al., 2022). So this research will develop comics using the Plomp method using the local context.

Previous research has shown that an ethnomathematics approach can increase students' understanding of mathematical concepts and strengthen their emotional attachment to learning. Therefore, in this project, we aim to develop comics based on traditional ethnomathematics of Probolinggo culture on geometry materials for primary and secondary-level students. Therefore, from the explanation above, this research raises the title of developing comics based on ethnomathematics of traditional Probolinggo culture on geometric material for students.

RESEARCH METHODS

The research method uses research and development/ R&D). The R&D research method is a research method used to produce certain products and test the effectiveness of these products. Products resulting from this type of research can be in the form of objects and software, such as computer programs, and hardware, such as books, modules, worksheets, and others (Gustiani, 2022). Plomp's development compiles ethnomathematics-based comics of the Tengger traditional house. There are four stages to obtain a comic prototype that meets the criteria of validity and readability. The first stage is initial investigation, the second is design, the third is construction, and the last is test, evaluation, and revision.

The investigative phase is carried out to investigate why it is necessary to develop an ethnomathematics comic of the Tengger traditional house with triangular and quadrilateral material. Researchers used the design stage to design a comic framework

consisting of covers, characters, and selecting photos of the Tengger traditional house to be used.

After everything is ready, assemble the parts into a single unit to form the prototype I comic. Two validators, lecturers, and mathematics education teachers assessed and corrected the comic prototype. The comic prototype was given to the art teacher to see how legible it was. Suppose the validation and readability results do not meet the criteria. In that case, the comic prototype is corrected according to the suggestions and re-validated to obtain the final comic prototype.

The assessment of the comic prototype from the validator consisted of content, construction, and design aspects with a rating selection of 1 to 5. The content aspect consisted of 12 questions, the constructed aspect consisted of 10 questions, and the design aspect consisted of 8 questions. The assessment from the art teacher consists of aspects of content, design, and visual communication. The following are the validity criteria used to determine whether a valid comic draft is presented in Table 1.

Table 1. Comic Validity Interval

N o.	Interval	Kriteria
1	$1 \leq V < 2$	Tidak valid
2	$2 \leq V < 3$	Kurang Valid
3	$3 \leq V < 4$	Cukup Valid
4	$4 \leq V < 5$	Valid
5	$V = 5$	Sangat Valid

RESULTS AND DISCUSSION

Investigation Stage

Researchers at this stage conducted a study and analysis of mathematics teachers, MTs geometry material, and Tengger Culture. The first step was to investigate mathematics teachers by collecting data through interviews to explore ethnomathematics information on learning geometry. Mathematics teachers need to become more familiar with ethnomathematics in learning mathematics. They have never used elements of the Tengger Culture in learning geometry. Based on the results of the investigation of mathematics teachers, it is necessary to develop a geometry learning tool based on the ethnomathematics of the Tengger culture.

The second step explores geometry material considered problematic for students from several studies. Junior high school students struggle to identify rectangular objects in everyday life, analyze rectangular properties, and see the interrelationships between images (Utami et al., 2017). Students need higher relational understanding, geometry, and problem-solving skills (Irsal et al., 2017); (Riastuti et al., 2017). The students' low geometric abilities will make it easier for the teacher to bring up the students' HOTS abilities (Fajriah et al., 2020).

Based on the results of the material investigation, a way is needed to motivate students to be more interested in learning geometry so that their abilities increase. The focus of the material to be discussed is flat shape. The third step is exploring the Tengger traditional house, which can be related to flat geometric material. The method used is direct observation in the field and confirmed with relevant literature documents. Based on the results of field observations, it can be seen that there are a lot of mathematical elements, especially the flat shapes in the mosque building. So based on the investigation carried out, it can be concluded that the device to be developed is an ethnomathematics-

based comic media of the Tengger traditional house with triangular and quadrilateral material.

Design Stage

The research team discussed compiling a comic design that would be developed. The first step is to jointly choose photos based on observations that will be used in comic images. Next, determine the cover, characters, and learning scenarios that are tailored to the learning objectives to be achieved. The comic cover design is shown in Figure 1 below.



Figure 1: covers

Based on the results of the discussion obtained learning scenarios that are adapted to the objectives achieved, photos, characters, and learning scenarios that will be used in comics.

Construction Stage

It will produce prototype 1 (initial) at this stage due to product design realization. The resulting product is an ethnomathematics-based comic at the Jami Sungai Jingah Mosque. The prototype one comic design was carried out at this stage according to the initial design. This comic's design was based on the basic competencies of quadrilateral and triangle material in the 2013 Curriculum and the characteristics of class VII students at MTs connected to the Tengger Traditional House. This comic is designed to introduce the pre-arranged quadrilateral and triangular material modules.

Test, Evaluation, and Revision Stages

At this stage, prototype I, namely comics based on initial designs, was assessed by two validators. The prototype I was assessed by one mathematics education lecturer and a mathematics teacher. Each validator is given a comic along with the comic validation sheet. The validation results were in the form of a score to test the validity level of the comic, as well as suggestions and criticisms from the validator, which were used as revision material to produce prototype II. The validation results from the validator are shown in Table 2 below.

Table 2. Validator Assessment Results on Comics

No	Interval	Nilai	Kualifikasi
1	Isi	4,8	Valid
2	Konstruksi	4,7	Valid
3	Desan	4,7	Valid

Based on Table 2, the analysis of the validation sheet and the established validity criteria obtained the values of each aspect considered to have met the valid criteria. Furthermore, prototype I of the comic was improved based on the validator's suggestion,

namely to adjust between the written pictures and enlarged paper to be more interesting, and the material in the comic was very good. In addition to material validation, a media expert's assessment of comic readability was also carried out. The results of the comic prototype readability assessment are shown in Table 3 below.

Table 3. Readability Assessment Results

No	Aspek	Nilai
1	Isi	4,8
2	Desain	4,6
3	Komunikasi Visual	4,8

Based on Table 3, the media readability sheet analysis results obtained the value of each aspect considered to have met the readability criteria. The comments made by the teacher to test the readability of comics were that the comics developed were creative and interesting as a medium for learning mathematics, so they did not stop here but had to be developed for the advancement of education.

Changes to the characters' conversation descriptions in comics, namely, previously, there was no opening prayer in the conversation box. The improvement is added to the description of the conversation box from comic characters, namely the teacher carrying out prayers with students. Improvements can be seen in Figure 2 below.

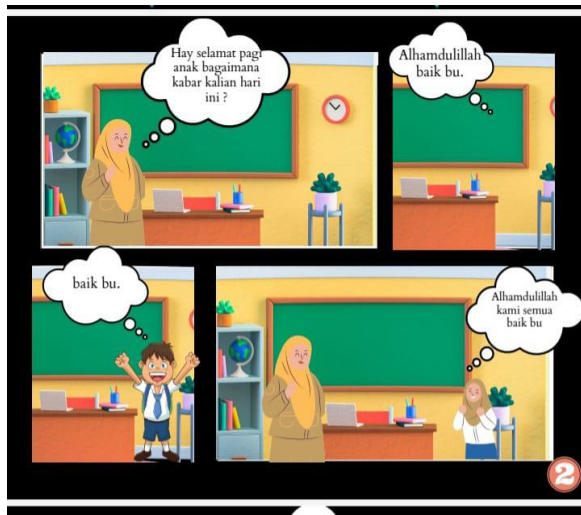


(a). Before Revision

(b). After Revision

Figure 2. Revised description of Comic Character Conversations

the classroom, which initially did not use a chair, was changed to use a chair. Improvements can be seen in Figure 3 below;



(a). Before Revision



(b). After Revision

Figure 3. Revision of background and space in Comics

Differences in teaching methods on comics. in picture (a), the teacher is still explaining how the traditional house of the tengger tribe is and students still don't understand for sure. While the comic image in part (b). the teacher has visualized through pictures of the traditional tengger house. This difference can be seen in Figure 4 below.



(a). Before Revision



(b). After Revision

Figure 4. Revision of teacher teaching drawings

The difference between the two pictures lies in the learning situation. in figure (a) learning tends to be dominated by the teacher and is passive. while in figure (b). Learning always involves students with a feedback system. learning tends to be active and fun. A more concrete explanation can be seen in Figure 5 below



(a). Before Revision

(b). After Revision

Figure 5. Revision of teacher teaching drawings

Differences in the flow of learning, in figure (a) the learning flow is so fast and short that it is very difficult for students to understand the material. different from the one in picture (b). systematic learning, often providing a stimulus to students and clear and clear explanations from the teacher, evaluating students' understanding and ending with a closing prayer and greeting. These differences can be seen in Figure 6 below.

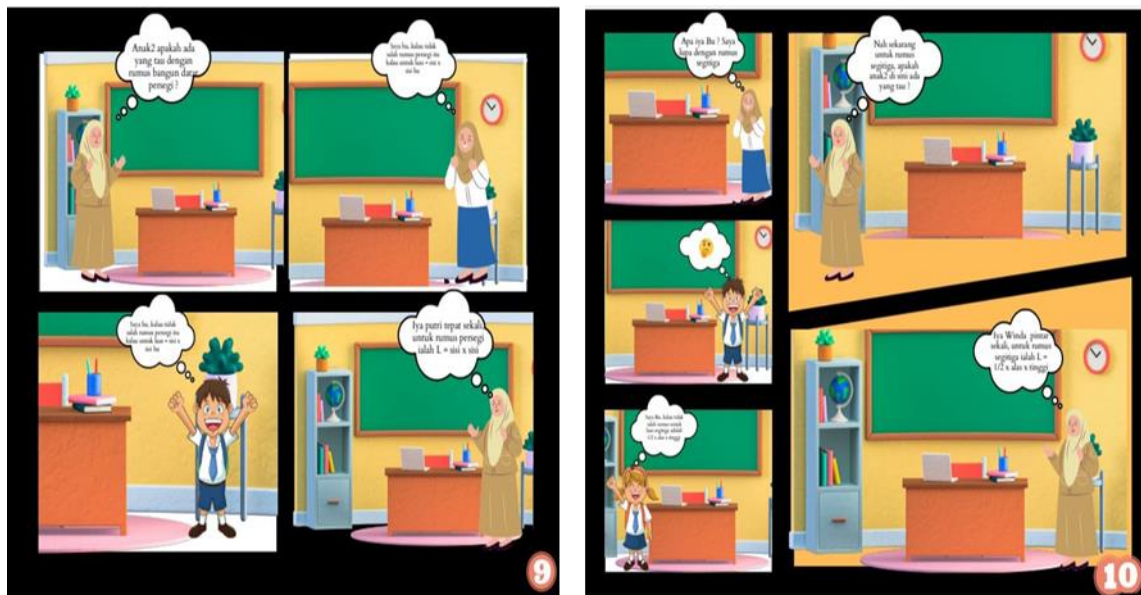


Figure (a) before Revision



Figure (b) After Revision

After carrying out an analysis based on the results of the validation and readability of the comics developed, the comics developed were declared to have met the criteria worthy of being called the final prototype. The comics developed are expected to help attract students' interest to maximize their learning outcomes, as has been the experience of several researchers. Comics influence student learning outcomes and reading interest in science subjects (Widyawati et al., 2019). Development of comic media for learning logic and computer algorithms (Rahmatin et al., 2021). In addition, developing ethnomathematics-based comics on traditional Probolinggo culture on geometry material for students at MTs Uswatun Hasanah adds to the repertoire of comics based on Indonesian culture. The developed comic media also enriches ethnomathematics research on local culture in mathematics learning tools.

CONCLUSION

The development research based on Plomp's 6-stage framework produced a comic prototype based on the ethnomathematics of traditional Probolinggo culture in geometry that met the criteria of validity and readability. This research needs to be continued for the implementation phase for MTs Uswatun Hasanah students in the school environment as a continuation of the Plomp development research stage.

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