

Mathematical Comic Design to Improve Ability Numerical Literacy and Student Learning Motivation

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ABSTRACT

Numerical literacy is the ability to use numbers, data, and symbols. For that, we need learning media that can accommodate this. Teaching materials that have not integrated numeracy literacy skills need to be developed. Therefore, the purpose of this research is to design mathematical comics to improve students' numeracy literacy skills and learning motivation. This type of research is development research using the ADDIE model. Namely analyzing, designing, developing, implementing, and evaluating. Data collection techniques used interviews, observations, questionnaires, tests, and validation questionnaires from material and media experts. Sources of data in this study were self-class VIII MTs Kalipucang, Indonesia, two material expert validators, and two media expert validators. The results of this study indicate that (1) numeracy literacy skills and student learning motivation still tend to be low so that teaching materials are needed to improve these abilities, (2) the teaching materials developed in this study are mathematical comics made using Adobe Photoshop then made interactive with the help of live worksheet websites; (3) the mathematical comic design consists of 3 volumes and contains basic competencies, practice questions according to numeracy literacy indicators, and an attractive appearance to increase students' interest in learning; (4) the results of the validation of material experts and media experts indicate that the score is in a good category, so it is declared valid to be used. This research will continue to the implementation and evaluation stages.

Keywords: *Mathematical Comics; Numerical Literacy Ability; Motivation to learn*

INTRODUCTION

Mathematics is the main component of the intelligence of human thinking and the revolution of modern science and technology today (Ernest, 2015: 187). When learning mathematics appears students' thinking processes to search for, manage, and utilize existing information to get a conclusion and solve daily problems (Nahdi et al, 2020: 19). This is one of the reasons why mathematics is a subject taught at all levels of education, including junior secondary education (Sholihah & Mahmudi, 2015: 2). But the fact is that many students do not like mathematics because they consider mathematics as a complex, confusing and uninteresting subject (Anita, 2014: 2). This causes some students to lose concentration and fail to achieve maximum scores in learning mathematics. In addition, one of the causes of students not being interested in learning mathematics is when presenting material in class the teacher only conveys material without being accompanied by interesting learning media. Class VIII students of MTs Kalipucang, are more willing to learn to use interesting teaching materials as an illustration of learning materials such as math comics, not just ordinary textbooks that contain writing.

The simple nature of comics, with story elements containing important information, makes comics can be used as learning media (Munadi in Dewi, 2017: 68). Comics can also be made more interesting and interactive by combining interactive multimedia concepts to realize the effectiveness of readers in understanding scientific material (Saputro et al, 2016: 196). However, not only in science but also in students' numeracy literacy skills which are indispensable, such as using numbers, data, and mathematical symbols (De Lange, 2006: 1). Numerical literacy is the ability to use numbers, data, and symbols related

to basic mathematics, to analyze various forms of information, graphs, tables, charts, etc., as well as the ability to conclude.

Facts in the field show that students' numeracy literacy skills still tend to be low (Muhazir et al, 2020: 229). So that the numeracy literacy skills of junior high school students need to be improved to show problem-solving skills, use data and numbers, operate mathematical symbols, and draw decisions from calculations. The low numeracy literacy of students can also be caused by a lack of learning motivation in students during the mathematics learning process (Antika, 2015: 5). So that the learning outcomes obtained are less than optimal. Optimal learning outcomes can be achieved with high motivation to learn independently, students will easily understand and follow learning so that the expected learning effect is achieved (Mujawal et al, 2019: 2). Learning motivation needs to be increased as an encouragement for students to carry out learning activities to achieve optimal learning outcomes (Judge in Suprihatin, 2015: 74). One of the instruments that can be used to achieve optimal learning objectives is teaching materials (Marhaeni & Suparman, 2018: 119). The teaching materials that will be developed by the researchers are comics. Based on this description, the researcher intends to describe the design of mathematical comics to improve numeracy literacy skills and the learning motivation of class VIII SMP/MTs students.

METHOD

This type of research is research and development with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This study aims to analyze students' needs for teaching materials that can facilitate students to find and construct numeracy aspects in Pythagorean material and determine the validity of the product. Sources of data from this study were class VIII B MTs Kalipucang totaling 21 students, two material expert validators, and two media expert validators. The time of this research is in October – December 2021. Data collection techniques use interviews, observations, questionnaires, concept understanding ability tests, media expert validation questionnaires, and material expert validation questionnaires. Observations were made in the classroom during the learning process, while interviews were conducted with the seventh-grade mathematics teacher at SMPN 1 Sungailiat regarding the curriculum, learning methods, student characteristics, obstacles during mathematics learning, and also the need for electronic mathematics teaching materials. For the test, the test was conducted to determine the students' conceptual understanding ability. As well as for the questionnaire conducted to find out the mobile devices that students use and to find out what kind of learning students are interested in. While the validation questionnaire is used to determine the validity score of the product being developed. Where if the total score is in a good category then the product is declared valid. The research will still be continued at the implementation and evaluation stages.

RESULT AND DISCUSSION

The development model used in this research is the ADDIE model. The ADDIE model is one of the systematic development models. The selection of this model was based on the consideration that this model was developed systematically and based on theoretical learning design. In this research, there have been 3 stages of ADDIE development, namely the analysis stage, the design stage, and the development stage.

Result

- **Analyze**

This analysis phase was carried out by researchers by analyzing the curriculum used during learning, learning methods, learning resources, and the characteristics of class VIII MTs Kalipucang students. To obtain the data needed to maximize this stage of analysis, the researchers conducted observations, interviews, questionnaires, and gave preliminary test questions to determine the extent of students' numeracy literacy abilities. At the observation stage, the researcher observed students during the mathematics learning process. Interviews were conducted with mathematics teachers to determine the curriculum, student characteristics, and obstacles during the mathematics learning process. Questionnaires were given to determine the level of students' learning motivation during the learning process and what kind of media the students were interested in. Furthermore, giving test questions is done by giving numeracy literacy questions on quadrilateral and triangle material.

- a. Curriculum Analysis

Based on Law No. 20 of 2003, the curriculum is a set of plans and arrangements regarding the objectives, content, and learning materials as well as the methods used as guidelines for the implementation of learning activities to achieve certain educational goals. The purpose of this curriculum analysis is to find out the curriculum used during the learning process. From the results of interviews and observations made by researchers, it is known that the curriculum used in class VIII MTs Kalipucang is an emergency curriculum considering that currently, the Covid-19 pandemic is still there. Teachers already have a manual for making lesson plans, basic competencies, and indicators of student competency achievement by the curriculum. Based on the curriculum used, the following are the basic competencies in the Pythagorean theorem.

Tabel 1. Basic competencies

No.	Basic competencies
3.6	Explain and prove the Pythagorean theorem and the Pythagorean triple
4.6	Solve problems related to the Pythagorean theorem and Pythagorean triples

b. Learning Model Analysis

During the COVID-19 pandemic, limited face-to-face learning has been carried out. Where each subject is only given 45 minutes. Based on the results of the interviews, it was found that the teaching methods used were lecture and question and answer methods. Teachers have not been able to use the learning model before the pandemic due to very limited time. From the interviews, it was also found that this learning model cannot be said to be an effective learning method because students are still less active in answering the questions asked, so it can be concluded that the learning methods used today have not fully been able to improve numeracy literacy skills and students' learning motivation.

c. Analysis of Learning Resources

Based on the results of observations and interviews, it is known that the teaching materials used in the mathematics learning process are LKS books that are not from the department. So that the book is not enough to be able to improve students' numeracy literacy skills. In addition, the appearance of the LKS book used is also less attractive because it only has two colors, namely black and white. The pictures used in the LKS book also do not attract attention so that students are not motivated to learn. During the interview, the teacher also said that there were no learning media that he had developed so far, and also the teacher had never used teaching materials assisted by math comics during face-to-face learning during the pandemic.

d. Analysis of student characteristics

Analysis of Student Characteristics was carried out to determine the character, activities, and constraints of students during the mathematics learning process. Based on the results of interviews with teachers, researchers know that during the mathematics learning process students tend to be passive and also get bored quickly. Students are less focused when the learning process takes place. In addition, based on the results of the questionnaire, it was found that as many as 73% of students had difficulty working on math problems related to numeracy literacy, and as many as 54% of students were classified as having low learning motivation. The graphs of numeracy literacy test scores and students' learning motivation are shown in Figures 1 and 2.

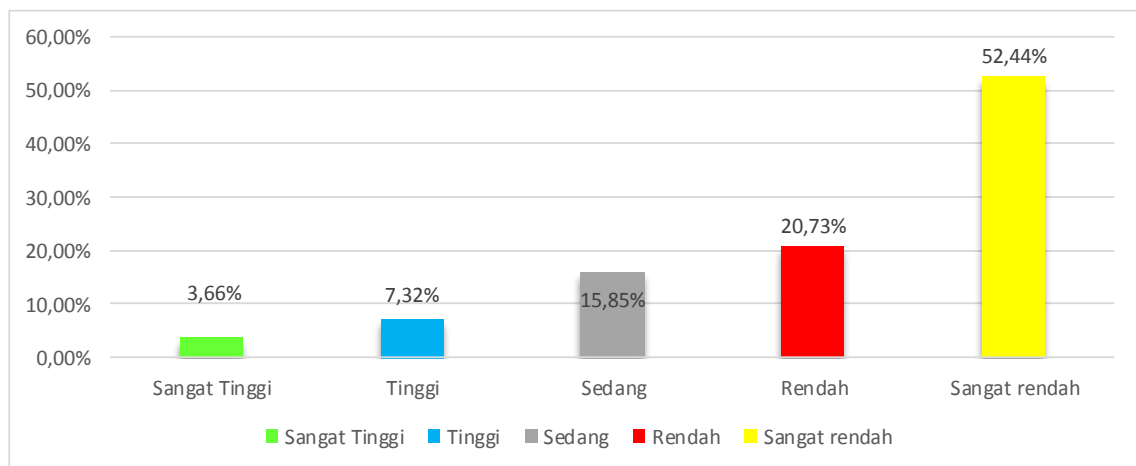


Figure 1. Results of the Numerical Literacy Test Scores for Class VIII B MTs Kalipucang

In addition, based on the results of the numeracy literacy test consisting of 5 description questions, it was found that the students' numeracy literacy ability was still relatively low. Where the average value of the student's numeracy literacy test is 61.46, which is quite far from the KKM with a value of 76. From the interviews, it is also known that, when the teacher gives questions to students, they work on the problem without paying attention to the steps for completing numeracy literacy skills. This indicates that students' numeracy literacy skills are still low.

Based on the results of interviews with several students of class VIII B MTs Kalipucang, they are more willing to learn to use interesting teaching materials as an illustration of learning material, not just ordinary textbooks that contain writing. Based on the explanation above, this shows that students need learning media to stimulate their numeracy literacy skills and learning motivation. The results of the interpretation of the student learning motivation questionnaire are as follows:

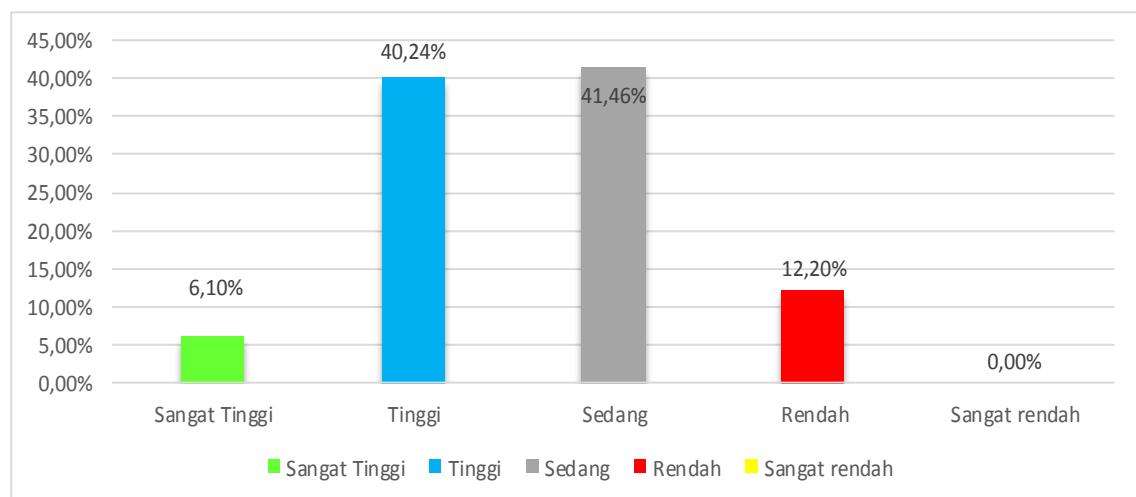


Figure 2. Results of the Student Learning Motivation Questionnaire for Class VIII MTs Kalipucang

- Design

The design stage is the stage where the researcher makes a product description design that he wants to develop based on the results of the analysis that has been done. At this stage, the researcher chose a product that was developed in the form of a mathematical comic based on the Pythagorean theorem material, then the researcher made the framework and content of the mathematical comic by the basic competencies that had been made. This mathematical comic contains indicators of numeracy literacy skills which include the use of numbers and symbols related to operations in the form of the

Pythagorean theorem in solving daily problems, analyzing information (graphs, tables, etc.), and drawing conclusions from calculations. Here are the results of the initial design.

a. Cover

The title on the cover is KOMA “Mathematical Comics” Pythagorean Theorem Material. This math comic was designed by using indicators of numeracy literacy skills in the Pythagorean theorem material for class VIII SMP/MTs. The cover is shown in figure 4.



Figure 4. Cover

b. Contents

Learning materials that must be studied by students can be seen in Figure 5.



Figure 5. Contents

c. Practice Questions

For practice questions, it is adjusted to the numeracy literacy ability indicator.



Figure 6. Practice Questions

d. Final Task

For the final task, adjust the numeracy literacy ability indicators in the previous material.

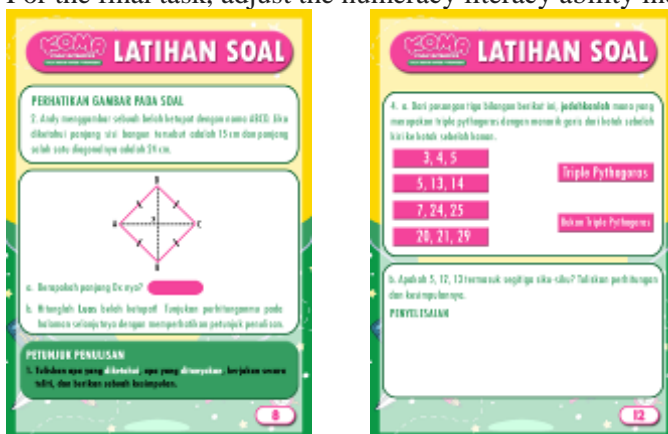


Figure 7. Final Task

- Development

At the development stage, the researcher translates the design at the design stage into physical form, so that this activity produces a prototype of a development product in the form of mathematical comics to improve numeracy literacy skills and student learning motivation. In addition, the researchers also compiled a validation sheet for media experts, material experts, student response questionnaire sheets, pretest and posttest sheets for numeracy literacy skills. Based on the results of the validators of media experts and material experts. The instrument is declared valid and feasible to use. After that, the researcher continued the development stage by validating mathematical comics. The following are comments, suggestions, and input from material experts which are summarized in table 2 below.

No	Feedback and Suggestions	Follow-Up
1	Do not use rank writing (^)	You can write rank on mobile by long-pressing the desired number key
2	Give a discussion that can help students correct their answers	Given a discussion link from the questions on the last page after finishing working
3	The design is tailored to the user's needs	The design has been changed according to the user's needs
4	In the beginning, an interesting video can be given	An animated video is given at the beginning of the math comic

The results of the design validation student worksheet assessment were obtained from the validation of the instructional media design using a Likert Scale. The Likert scale is a scale used to measure certain problems. After validating the results obtained, the results are compared with the ideal assessment criteria table, in table 3 and table 4.

Table 3. Material Expert Validator

No	Skor	Kriteria
1	$60 < \bar{X}$	Very good
2	$45 < \bar{X} \leq 60$	Good
3	$30 < \bar{X} \leq 45$	Enough
4	$15 < \bar{X} \leq 30$	Not enough
5	$60 < \bar{X}$	Very less

Table 4. Media Expert Validator

No	Skor	Kriteria
1	$56 < \bar{X}$	Very good
2	$42 < \bar{X} \leq 56$	Good
3	$28 < \bar{X} \leq 42$	Enough
4	$14 < \bar{X} \leq 28$	Not enough
5	$\bar{X} \leq 14$	Very less

The results of the validation of the Mathematical Comics design in below.

Table 3.1 Data on the Validity Score of Mathematical Comic Material Experts

Ageng Triyono, M.Pd.	Lecture in College of Teacher Training and Education Kusuma Negara and Curriculum Researchers & Developer Widya Edutech – PT Widya Kreasi Bangsa	70	Very Good
Aditya Prasetyaningtyas, M.Pd.	Teacher at Junior High School 1 Way Tenong	72	Very Good
The number of validator scores 1 and 2		142	Very Good

Table 4.1 Data on the Validity Score of Mathematical Comic Media Experts

Validator	Position	Score	Criteria
Dr. Suharno, S.Pd., S.Pd.T., M.Pd.	Lecture in Mathematics Education at Mercuru Buana University of Yogyakarta	66	Very Good
Bayu Sudarmaji, S.Pd.	Principal of Vocational high school Assalafiyah Sleman and Manager at CV ASA Multimedia	52	Good
The number of validator scores 1 and 2		118	Very Good

Discussion

The purpose of this study was to develop a mathematical comics learning media that was declared valid to be used by media experts and material experts. At the design stage, the researcher considers input from students regarding media that is attractive to students and can improve numeracy literacy skills and students' learning motivation. So that the developed media contains materials, videos, and quizzes that are by the problems in everyday life. At the development stage, the researcher asked for opinions from two material expert validators and two media expert validators. For material experts to provide media input and suggestions, namely; (1) writing ranks do not use (^), (2) provide a discussion that can help students correct their answers. From this input, the researcher has corrected and discussed it again with the validator so that the product is declared valid to be used. In addition, two media expert validators provided input and suggestions, namely (1) mathematical comic design adapted to its users, (2) at the beginning of the comic an interesting video could be given. This has also been improved and revised by researchers. So from the validator aspect, the product has been declared valid to be used.

The things that were taken into consideration by researchers in designing mathematics comics learning media to improve students' numeracy literacy skills and learning motivation were because there had been similar research, namely, the results of research conducted by Mujawal, et al., (2019) entitled "Use of Comic Media in Mathematics Learning to Improve Student Motivation and Learning Outcomes on SPLDV Materials" and. The research shows that the validity of the developed media is very valid with a percentage score of 80% from material experts and a score of 94.56% from media experts. For the practical aspect, the average score is 86.83%, which means that the learning media developed is very practical. The research concludes that the product in the study can be used to improve students' numeracy literacy skills and learning motivation.

CONCLUSION

The results of this study indicate that (1) numeracy literacy skills and student learning motivation

still tend to be low so that teaching materials are needed to improve these abilities, (2) the teaching materials developed in this study are mathematical comics made using Adobe Photoshop then made interactive with the help of live worksheet websites; (3) the mathematical comic design consists of 3 volumes and contains basic competencies, practice questions according to numeracy literacy indicators, and an attractive appearance to increase students' interest in learning; (4) the results of the validation of material experts and media experts showed that the scores were in a good category so that they were declared valid to be used with a total score of 260 points from material experts and media experts. This research will continue to the implementation and evaluation stages.

REFERENCES

- Abidin, Y., Mulyati, T., & Yunansah, H. (2021). *Pembelajaran Literasi: Strategi Meningkatkan Kemampuan Literasi Matematika, Sains, Membaca, dan Menulis*. Jakarta: Bumi Aksara.
- Anita, A. (2014). *Pengaruh Media Komik Terhadap Hasil Belajar Matematika Siswa pada Konsep Faktor dan Kelipatan (Kuasi Eksperimen di SDN Muhara 02 Citeureup)*. Jakarta: Universitas Islam Negeri Syarif Hidayatullah Jakarta.
- Antika, R. (2015). *Pembelajaran Matematika Kontekstual Untuk Meningkatkan Literasi Matematis dan Motivasi Belajar Siswa SMP* (Doctoral dissertation, Universitas Pendidikan Indonesia).
- De Lange, J. (2006). *Mathematical literacy for living from OECD-PISA perspective*.
- Depdiknas. (2014). *Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 58 Tahun 2014 Tentang Kurikulum 2013 Sekolah Menengah Pertama/ Madrasah Tsanawiyah*. Jakarta: Depdiknas
- Dewi, C. (2017). Pengembangan Komik Fabel Sebagai Suplemen Pendidikan Lingkungan Dalam Rangka Kampanye Pelestarian Flora Dan Fauna Bagi Siswa Kelas 1 Mi Al–Abror Magetan Tahun 2016/2017. *Muaddib: Studi Kependidikan dan Keislaman*, 7(1), 67-71.
- Ernest, P. (2015). The social outcomes of learning mathematics Standard, unintended or visionary. *International Journal of Education in Mathematics, Science and Technology*, 3(3), 187-192.
- Heidjrachman & Suad Husnan (Ed. 4). 1997. *Manajemen Personalia*. Yogyakarta: BPFE UGM
- Marhaeni, N. H., & Suparman. (2018). Analisis Kebutuhan Bahan Ajar Matematika Berbasis *Problem Based Learning* Untuk Mengembangkan Kemampuan Pemecahan Masalah Siswa SMA Kelas XI. *Prosiding Seminar Nasional Pendidikan Matematika Ahmad Dahlan 2018*. 2018. Yogyakarta: 3 November 2018. Hal. 118 – 123.
- Muhazir, A., Hidayati, K., & Retnawati, H. (2020). Literasi Matematis Dan Self-Efficacysiswa Ditinjau Dari Perbedaan Kebijakan Sistem Zonasi. *Pythagoras*, 15(2).
- Mujawal, W., Bani, A., & La Nani, K. (2019). Penggunaan Media Komik dalam Pembelajaran Matematika untuk Meningkatkan Motivasi dan Hasil Belajar Siswa pada Materi SPLDV. *Delta-Pi: Jurnal Matematika dan Pendidikan Matematika*, 7(1).
- Nahdi, D. S., Jatisunda, M. G., Cahyaningsih, U., & Suciawati, V. (2020). *Pre-service teacher's ability in solving mathematics problem viewed from numeracy literacy skills*. *ilkogretim Online*, 19(4).
- Saputro, G. E., Haryadi, T., & Yanuarsari, D. H. (2016). Perancangan Purwarupa Komik Interaktif Safety Riding Berkonsep Digital Storytelling. *Andharupa: Jurnal Desain Komunikasi Visual & Multimedia*, 2(2), 195-206.
- Sholihah, D. A., & Mahmudi, A. (2015). Keefektifan experiential learning pembelajaran matematika MTs materi bangun ruang sisi datar. *Jurnal riset pendidikan matematika*, 2(2), 175-185.
- Suprihatin, S. (2015). Upaya Guru Dalam Meningkatkan Motivasi Belajar Siswa. *Jurnal Pendidikan Ekonomi UM Metro*, 3(1), 73-82.