Production of Comic Books Using a Scientific Method to Enhance Students' Representation Ability and Mathematical Concept Understanding At Smp Level

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Abstract. This study's goal was to: 1) validity of the comic 2) practicality of comic; 3) effectiveness of comic 4) how to improve students' representation ability and understanding of concepts with comic. The model used is the ADDIE development. With an average score of 96.51%, the results demonstrated how valid the comics that were created. Comics were also very practical with an teacher's questionnaire score of 4.866 with a percentage of 97.30%, as well as a questionnaire score for filling out the practicality questionnaire sheet of 4.777 with a percentage of 95%. 3) The developed comics are effective with pretest of 59.306 and postest of 93.61 for representation ability, as well as pretest of 62.917 and postest of 94.861 for concept understanding ability; 4) With an n-gain score of 0.84 for representation ability and an n-gain score of 0.86 for concept understanding with a high improvement category.

Keywords: Comic Media Development, ADDIE Model, Scientific Approach, Representation, Concept Understanding..

1 Introduction

The curriculum serves as a guideline to achieve learning objectives at school. The 2013 curriculum is currently used in Indonesia as a learning guideline. All educational levels, including elementary school, junior high school, and senior high school, require pupils to take mathematics. It is evident that mathematics plays a critical role in human existence, so that every level of education does not escape mathematics lessons. Basically, Learning mathematics is meant to assist students in learning mathematics because mathematics has many questions that can improve their thinking skills.

In line with this, literacy is needed in learning. The Literacy Movement is one way to implement educational programs. According to Sari, The capacity to read, write, listen, and read correctly is known as literacy, and it can help people find information and communicate effectively[1]. Some ideas that can encourage the literacy movement in learning are using media, such as comics. Comics can be used in math lessons to foster students' interest in

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reading and help them understand math through what they read. As stated to Rosadi and Karimah's research, Two essential components of the learning process in the classroom are assistance and interest in the work being done by the students. As a result, educators must employ teaching strategies that can draw in and raise students' motivation for learning, like the use of comic books.[2]

According to data from the Ministry of Education and Culture, Indonesia continues to lag behind other nations in terms of math learning outcomes, which indicates the low quality of education in our country. Based on the results of the Organization for Economic Co-operation and Development's Programme for International Student Assessment, Indonesian students received an average score of 371 in reading, compared to an OECD average of 487. In addition, Indonesian students' average score was only 379, in contrast to the 487 average of the OECD. Indonesian students scored 389 on average in science, compared to a 489 average for the OECD. The skills of Indonesian students reveal that they continue to lag behind in science, math, and reading. The results show that Indonesian children's abilities need to be improved again, especially in terms of math[3].

Six standards for mathematical abilities The National Association of Mathematical Teachers founded them in 2000. These standards include understanding, proficiency in problem-solving, communication, connection-making, reasoning, and representation. According to Pianda, et al. that learning mathematics at school includes understanding concepts and memorizing formula skills. Not only the results, but also the methods used to solve these problems by considering students' thinking abilities[4] . Therefore, appropriate learning is needed to improve students' representation skills and understanding of mathematical concepts, one of which is by using comic media in learning. This is needed so that students can more easily understand and learn math lessons.

Knowing something and being able to examine it from different angles are two aspects of understanding. Put differently, understanding is the capacity of an individual to perceive, understand, and retain information after it has been learned and retained. Representation is the way students show how they think about a problem in a way that helps them solve it.[6] Students must have both abilities in order to understand lessons, especially math lessons. Development of E-Comic Media to Enhance Students' Conceptual Understanding of Mathematics was published in a journal, Afifah and Dewi found that e-comics are considered effective as a learning tool to enhance pupils' comprehension of mathematical ideas. This is because the results of the percentage effectiveness criteria have achieved student learning completeness. The findings demonstrated that using comic books in the classroom can enhance students' comprehension of mathematical ideas and representation abilities [7].

Comics are pictures arranged in rational manner that are employed to convey messages or encourage natural responses from students [8]. Based on the things conveyed above, with the background of the problem, observation, and some supporting research, researchers offer learning through comic media.

2 Methods

The ADDIE model is used for development research, which is designed in five stages: analysis, design, development, implementation, and evaluation[8]. Therefore, this model can be used to create various products, such as models, learning strategies, learning techniques, media, and teaching materials. The research subjects for students in Class VII at SMP Muhammadiyah 03 in Medan participated in this study, and the object of research was comic media with scientific learning on social arithmetic material, as shown in Figure 1. ADDIE model of development.

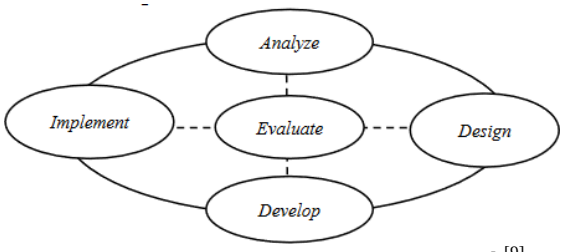

Fig. 1 ADDIE concept according to Branch[9]

A pretest-posttest design for a single group is shown in table 1 below.

Table 1 Implementation of the One Group Pretest - Posttest Design

Pretest	Treatment	*Posttest*
O_1	X_1	O_2

To measure the validity, practicality and effectiveness there are several formulas used. The formula utilized to ascertain the validity of comic educational materials is as follows[10]:

$$\text{Validity Score: } \frac{TSe}{FSh} \text{ x } 100\% \quad (1)$$

Table 2 lists the requirements for the validity level of educational media.

Table 2 Categories of Learning Media Validity Level

No.	Validation Criteria	Degree of Reliability
1	85,01 % - 100, 00 %	Very good, or doesn't require editing
2	70,01 % - 85,00 %	Applicable or reusable with modifications
3	50,01 % - 70,00 %	Diminished reliable; it is advised not to use it as it requires significant changes.
4	01,00 - 50,00 %	Not true, or not applicable

The formula used to determine practicality by observing the implementation of learning is as follows [11]

$$\text{Percentage of Choice} = \frac{Score\ obtained\ on\ the\ questuionnaire}{maximum\ score} \text{ x } 100\ \% \quad (2)$$

standards for practical learning media are listed in Table 3 below.

Table 3 Learning Level Categories of Execution

No.	Percentage (%)	Practicality Criteria
1	80 - 100	Very practical, without editing
2	66 - 79	Practical, without editing
3	56 - 65	Practical enough, without editing
4	40 - 55	Less practical, revision required
5	40 - 39	Not practical, revision required

When establishing the minimal requirements for concept comprehension and representation ability the Minimum Completeness Criteria serve as its guidelines (KKM) ≥ 70. Table 4 presents the following information about the interval of mastery criteria.

Table 4 Student Mastery Level

No.	Value Interval	Description of Learning Success
1	BK < 55	Diminished
2	55 ≤ BK < 70	Simply
3	70 ≤ BK < 85	Good
4	85 ≤ BK≤ 100	Very good

To ascertain each student's percentage of learning, you can use the following formula.:

$$KB = \frac{T}{T_t} \times 100\% \quad (3)$$

The following is the improvement in students' representation skills and comprehension of mathematical ideas derived from the normalized gain index data:

$$N - Gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (4)$$

The criteria for the normalized gain index are shown in Table 5 below

Table 5 ***N-Gain*** Score Categories

N-Gain Score	*N-Gain* Criteria
0,00 < N – Gain ≤ 0,30	Low
0,30 < N- Gain ≤ 0,70	Medium
N - Gain > 0,70	High

3. Results

3.1. Validity of Comic Learning Media

In general, the results obtained from the three validators that the comic is suitable for use without revision with an average score of 96.51% as presented in the following table:

Table 6 Comic Validation Results

No.	Validator	Score	Description
1	Dr. Arnita, M.Si.	100%	Very valid
2	Dr. KMS. Amin Fauzi, M.Pd.	89,52%	Very valid

3	Dr. Waminton Rajagukguk, M.Pd	100%	Very valid
	Average	96,51%	Very valid

3.2. Practically of Comic Learning Media

To assess the practicality of the educational materials created, this research uses a learning implementation observation questionnaire and a student response questionnaire. This is done to ensure that the expected level of learning is well met, so that the learning media made is considered practical. Table 7 shows the results of the learning implementation observation.

Table 7 Results of Implementation Questionnaire and Student Response

	Questionnaire Type	
	Learning Implementation	Learner Response
Score	4,866	4,777
Percentage	97,30%	95%
Criteria	Very Practical	Very Practical

According to the data presented in Table 7, filling out the educator (teacher) affirmation questionnaire sheet, which falls into the category of "very practical," obtained a percentage of 97.30% and an average score of 4.866; completing the student practicality questionnaire with a 95% completion rate and an average score of 4.777. Both of these presentation results resulted in the "Very Practical" practicality criteria

3.3. Efficiency of Comic Learning Media

The following is presented in Table 8 regarding the level of student mastery in representing data mathematically.

Table 8 Pretest Results of Mathematical Representation Ability and Understanding of Mathematical Concepts

Mathematical Ability	Average Score
Representation Ability	59,306
Concept Understanding Ability	62,917

Considering the above table, the pre-test results of representation ability averaged 59.306 and concept understanding ability averaged 62.917. These results show that the degree of student mastery is still in the "sufficient" range

Table 9 Results of the Concept Understanding and Mathematical Representation Posttest

Mathematical Ability	Average Score
Representation Ability	93,611
Concept Understanding Ability	94, 861

Based on the table above, Following the test, the average representation ability score is 93.611, and the average concept understanding capacity post test result is 94.861. The information indicates that the proficiency level of students in the "very good" range.

3.4. Improved Representation Ability and Concept Understanding

Based on the N-gain computation's outcomes using the Ideal Maximum Score (SMI) = 100, the normalized gain score's outcomes in the table are as follows:

Table 10 N-gain Score Results

Ability	Score	Criteria
Mathematical Representation	0,84	High Improvement
Mathematical Concept Understanding	0,86	High Improvement

Considering the information in the preceding table, The representation ability has an n-gain score of 0.84, as can be observed and The n-gain score for the mathematical concept comprehension skills is 0.86, which demonstrates that both fall into the category of significant improvement. This information suggests that comic books are a useful tool for teaching arithmetic.

4.Discussion

The result of this research is a mathematical comic media using a methodical approach to social arithmetic material in class VII. This study set out to ascertain whether the comics were valid, practical, and effective to get better the representation ability and understanding of mathematical concepts of Muhammadiyah 03 Medan students in junior high school in grade VII. The ADDIE model is the development methodology used to create comic media, which is divided into phases for analysis, design, development, implementation, and evaluation. Students in class VII Ibrahim SMP Muhammadiyah 03 Medan served as the research subjects, comic media used in learning is useful to find out whether comic media is effective to improve representation ability and understanding of mathematical concepts. Prior to using comic books in the classroom, experts validate comics first..

The comic validation process is carried out to evaluate the quality of comics based on elements of content feasibility, presentation feasibility, and language feasibility. With a score of 96.51%, the quantitative data illustrating the comic validation results indicates that the created comics are highly valid. The findings of this investigation are consistent with a study by Umroh et al. titled "Development of Unity of Sciences- based Mathematics Learning Modules on the Subject Matter of Class VII MTs" showing that the modules developed have sufficient validity and are practical, because they are easy to use in learning mathematics at school[12].

The data collected to assess the practicality of educators and students through filling out the questionnaire sheet for the practicality of educators (teachers), with 4.866 as the average score and a 97.30% percentage along with an practical statement, when completing the practicality questionnaire, students receive an average score of 4.777 and a percentage of 95%.

The outcomes of the pre-tests and post-tests were assessed to evaluate effectiveness. The pretest results of students' mathematical representation ability were on average lower than the post-test results, namely 59.306 and 93.611. The average students' mathematical concept understanding ability pretest results were lower than the post-test results, namely 62.917 and 94.861. Based on these data, the comic media is in the "very good" category. So, it can be said that comics are an effective learning tool for teaching.

Then the Normalized Gain test findings to see the improvement of pupils' capacity for representation and understanding of mathematical concepts, with a gain score normalized to 0.84 on representation skills and 0.86 for concept understanding skills. It the high improvement category as a result. So, the conclusion is that comic learning with a scientific approach has improved. Thus, comic media can be used in learning.

In line with research conducted by Fikriani and Nurva (2020), entitled " Creation of Comic-Shape Teaching Resources for Mathematics to Improve Mathematical Ability of Grade VII Junior High School Students", found that the comics were very valid with a percentage of 90%, very practical with a percentage of 83.5%, and effective for improving students' mathematical abilities with a percentage of 73%[13]. The facts above show that the comics developed help students in learning math, provide motivation and help them learn math. Additionally, comics are connected to social aritmathic content, so that students gain knowledge and can improve their representation skills and understanding of mathematical concepts.

5. Conclusion

By applying the analysis, design, development, implementation, and evaluation, the end result of this development investigation is comic media for learning mathematics using a scientific method to improve representation skills and understanding of mathematical concepts in class VII social arithmetic material, with the following results: (1) Validity, which means that the evaluation conducted by experts, comics can be used according to all validators. With an average score of 96.51%. So, comics designed with a scientific approach to improve students' mathematical representation and understanding skills belong to the extremely validity group. (2) Practicality, the results of the assessment of comics designed with a scientific approach to improve students' mathematical representation and understanding skills. With the results of the implementation questionnaire filled by the teacher, attained a 4.866 average score and a presentation of 97.30% with a excellent assertion. Although the outcomes of the student response survey revealed a score of 4.777 and a presentation of 95% with a very practical category. (3) Effectiveness, pre- and post-test findings, on pupils' mathematical representation capacity 59,306 and 93,611. The pretest and posttest results on the ability to understand the concept with a score of 62,917 and 94,861. Based on the posttest results, it is included in the very good category, and comic media is effectively used in learning. (4) With n-gain testing, the mathematical representation ability n-gain score was 0,84 and the n-gain score for comprehension of mathematical concepts was 0,86 with a high improvement category. This shows that the ability of representation and understanding of ideas grows with scientific approach learning using comic media.

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