Developing Teaching Materials Using Comic Media to Enhance Students’ Mathematical Communication

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Abstract. Teaching materials are a set of materials that are arranged systematically written or not, to create an environment or atmosphere that allows students to learn. The purpose of this study is to provide an overview of how the development of teaching materials using comic media that enhance mathematical communication, as well as feasible and effective teaching materials developed. Research method used in this research is Research and Development. In the sense of research contains about how to develop teaching materials through several stages such as validation by experts, as well as revisions. Sources of data used in this study were students and teachers SMK Bandung Barat. The results showed that the teaching materials developed feasible and effective use for students of class X SMK Bandung Barat. Teaching materials received a proper assessment of the experts after going through several stages of revision, in addition to the effective teaching materials used by students seen from the liveliness and the value of classical completeness that reaches more 85% of students. Based on the result of the research, it can be concluded that the developed teaching material gets the proper judgment from the expert, and effectively used in the learning by the students of X-1 Pharmacy class with the classical completeness reach 86% and the student activity is 91.4%.

1. Introduction
Communication is an important component in the learning process, including learning mathematics. Characteristics of mathematics is abstract, contain with terms and symbols, bring many students who accept all the knowledge without trying to understand what information was contained in there. Most students use the method of memorizing the formula to learn mathematics, whereas the essence of mathematics learning is not memorizing but as stated in Minister Rule [1].

The purpose of the fourth point of math instruction listed in Minister Rule [1] is students to be able to communicate ideas with symbols, tables, diagrams, or other media to clarify the situation or problem. It is clear that mathematical communication is one of the important capabilities that students must developed. But some research show that the ability of mathematical communication in Indonesia is still not good. According to Shadiq [8] results of the Center for the Development of Mathematics Teacher also revealed that in different parts of Indonesia, most students have difficulties in problem-solving problems and translating daily life into a mathematical model. This indicate that the communication skills and problem solving in mathematic of Indonesian students' are still poor.
This happens as a result from very rarely the students are required to provide explanations in mathematics lessons, so it is very strange for them to talk about mathematics. To reduce the occurrence of such things, students need to be accustomed communicate orally and writing ideas to others according to their own interpretation.

Communication is a very important part of mathematics and mathematics education. Communication is a way of sharing ideas and verify the reasoning. Through communication ideas can be rebound, improved, discussed, and developed. The process of communication also can helps build meaning, provide ideas and publish ideas. When students are challenged by their thinking and their ability to think about mathematics and communicate their thoughts orally or in writing, they are learning to explain and convince. Listening to other students' explanations, giving students the opportunity to develop their understanding (NCTM)[6].

We overcome this problem by introducing comic media as the development of teaching materials. Todays, teachers demands to use the right teaching materials as responsible for the learning process in the classroom, developing teaching materials in the form of media is needed to help the learning process. By applying scaffolding, strategies and a good teaching materials is expected to generate interest and motivation of students either in the form of methods or approaches through teaching materials with basis of the learning activities phase. Scaffolding is the support given to learners to learn and solve problems. Scaffolding can be a guidance, encouragement, warning, outlined problems into solving steps, giving examples, and other actions that enable learners to learn independently.

Several studies have shown that comic media have a positive impact on learning, action research shows that learning by using comics through cooperative learning model Student Team Achievement Division (STAD) can increase students' learning interest in mathematics (Wahyuni)[10]. Maulana [5] says matematikomik have significant effect to improve student's motivation and achievement; there is a significant and positive relationship between the increase of motivation with student learning achievement of student learning as the influence of matematikomik usage; and in general the students give a positive response to the learning of mathematics by using comics.

Teaching materials that will be the authors discussed in this research is the comic media, because the uniqueness of its function is as a teaching materials and can entertaining. Comics as a visual media is assumed to have an effect on the acquisition of knowledge as a result of learning, because it is able to attract interest and attention in conveying information. This is suitable with his role to visualize ideas or concept. Especially by seeing the tendency that the main consumers of comics are children from primary school to high school, although some of college students are still become consumers of comics. (Yakti)[11]

The use of comics as a teaching materials has an important role to increase students' interest in learning, because the presentation of comics takes students into a joyful atmosphere, thus creating joy in learning (DePorter, Reardon, and Nourie)[3]. The excitement in learning is a overflow of emotion that activates the nerves of the brain to be able to record lessons more easily. This is accord with Goleman's[4], "Research tells us that without emotional involvement, the brain's neural activity is less than it takes to attach a lesson to memory." Especially at school age most students still have visual learning styles that are more likely to activate their memories through images captured by the eye (DePorter and Hernacki)[2].

To overcome the above-mentioned weaknesses, a research has been carried out by developing teaching materials using comic media as method gives students opportunities to identify problems, collect required information, investigate and analyze the result of investigation and exploration to be applied in a new situation. By developing teaching materials using comic media of learning process, they will be able to construct their own knowledge and put it in their long-term memory permanently.

2. Research Methods
This research was the Research and Development procedure. This development research, referring to the model of Sugiyono [9] which has been modified at the stage. The subjects of this study were students of X-1 Pharmacy class at vocational schools. Instruments that used in this study are student
worksheets and observation sheets of learning activities. Methods of data collection conducted in this study is a validation questionnaire method, observation sheet and student learning outcomes. Data analysis method used is descriptive percentage. The first stages of research by analysing the potential and problems that exist about learning in vocational school in Bandung Barat, then make data collection to create teaching materials. The third stage start designing the initial teaching materials which are then validated by the experts, the validation process is revised according to the advice given by the expert afterwards. The revised teaching materials were tested on the use of small-scale teaching materials with 6 students, after a small-scale trial and then revised again before large-scale trials. Implementation of large-scale trials conducted learning by using teaching materials on 35 students, students give an advice to perfect the final product. Experts come from lecturers of FMIPA UPI and teachers of vocational schools, they are validating the teaching materials. Then the validation results in the form of suggestions and comments are used to improve the developed teaching materials. Subsequently validated or reassessed by experts.

3. Result and Discussions
In this case teaching materials using comic media are validated by material experts and media experts. Validation is done until the teaching materials are said to be feasible by experts. Expert validation results can be presented in Table 1.

| No. | Validator          | Percentage Score |
|-----|-------------------|------------------|
| 1   | Material Experts  | 91.5%            |
| 2   | Media Experts     | 90.5%            |

In table 1 it is clear that the feasibility percentage for validator is at very good criteria with the percentage of each is 91.5%, 90.5%, is in the range of 81% to 100%. This means teaching materials using comic media can be used in the learning process.

The effectiveness of teaching materials is measured based on student learning outcomes after learning using teaching materials that are prepared. Recapitulation of student learning outcomes on the use of developed learning materials is presented in Table 2.

| No. | Category                | Achievements |
|-----|-------------------------|--------------|
| 1   | Mean                    | 80.5         |
| 2   | Sum of students         | 35           |
| 3   | Highest score           | 91           |
| 4   | Lowest score            | 55           |
| 5   | Students complete (tuntas) | 30         |
| 6   | Students not complete (tidak tuntas) | 5        |
| 7   | Classical completeness  | 86%          |

From Table 2 can be seen from the total number of students who completed are 30 students with students’ learning completeness 86% classically with 80.5 average score. The successful of teaching materials because students can understand the teaching materials. This can be proven from the results of student responses states that 86% of students more easily understand the teaching materials using comic media. These results prove that the teaching materials using comic media effectively used for students of vocational schools. This is because the teaching materials by researchers different from the
existing teaching materials in schools. A research conducted by Purnomo [7], the application of teaching materials of research results positively affect the results of biology of students of SMP Al Irsyad, the positive influence as the impact of the application of teaching materials research results on the value of student learning outcomes. There are differences in achievement when using teaching materials due to differences in student activity in learning. Completed students are mostly students who have highly active learning and include the active student’s categories. Students of high activity categorized but not complete KKM or students with low activity category but thoroughly KKM mainly due to internal factors that exist within the student. Aspects of student activity are assessed by observers using observation sheets. Recapitulation of student activity observation is presented in Table 3.

| No. | Score Category | Criteria of Activity | Sum of Students | Percentage |
|-----|----------------|----------------------|-----------------|------------|
| 1.  | 87 – 100       | Very active          | 6               | 17%        |
| 2.  | 73 – 86        | Active               | 26              | 74%        |
| 3.  | 59 – 72        | Adequate             | 3               | 9%         |
| 4.  | 45 – 58        | Less active          | 0               | 0          |
| 5.  | ≤ 44           | Not active           | 0               | 0          |

Overall, it can be seen that the student activity in learning of the large-scale trial class is 91% taken from the percentage of very active and active student criteria, so it can be seen that student activeness level is in very active category. The results of this study indicate that teaching materials using comic media effectively used in learning, seen from the results of student activeness.

Developing teaching materials requires various stages, starts from preliminary studies, model formulation, validation, small-scale test, large-scale test, revision and final product. The teaching materials using comic media in this research have gone through various stages. Based on the data obtained can be concluded that the compiled teaching materials has met the aspects of feasibility in terms of both theoretical, characters and language.

In addition to those aspects of teacher and student responses that show how feasible the teaching materials, an important aspect to consider is the use of teaching materials in the classroom.

Based on small and large scale trials, evidenced seen by the results of analysis of student responses and student learning outcomes that students respond positively. Teachers also respond positively the teaching materials developed by the researcher. It can be seen by the good results of teacher response analysis. From the results of research and discussion of teaching materials using comic media are feasible to be used by students of vocational schools. From the results of research and discussion of teaching materials effectively used in learning in vocational schools. It was proven by positive responses given by teachers and students as well as students' classical completeness 86% has reached the criteria that is ≥ 85% of students have complete learning (KKM ≥ 75) with average student learning outcomes of 80,5.

4. Conclusion
Based on the result of the research, it can be concluded that the teaching materials using comic media feasible based on the standard assessment of BSNP 2006 textbook that has been modified. This can be seen from the percentage of validation of experts who judge feasible results. In addition, teaching materials using comic media effectively used in learning class at vocational schools. It is seen from the positive responses given by teachers and students and obtained learning completeness by 86%. Suggestions that can be submitted by the researcher is required further research at other schools with a wider scale to determine the level of effectiveness of teaching materials products using comic media.
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