Development of teaching materials in the linear program of class XI

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Abstract. The aim of this study is to know the development of educational comic to improve students’ understanding in a linear program in High School Class XI. This educational comic can be said valid to improve students’ understanding of a linear program in High School grade XI, and students’ response to learning by using comic media of education. The type of research used is qualitative research. Subjects in this study are the validation experts and students of class XI in SMA Negeri 8 Cirebon. Based on research conducted, the development of educational comic media has been in accordance with the expected goals. Validation performed by experts has a very valid validity rate with a percentage of 86.7%. Students’ response to the following learning using educational comic media equal to 76% with strong criteria. So, the conclusion of this research is educational comic media has been successful in its development because of the valid and strong response of students in learning.

1. Introduction

The Development of learning can be done in various modes, one of them by making an innovation such an interesting and a diverse learning aid for students. This learning tool can be learning resource or media that can facilitate teaching and learning process. USAID (United States Agency for International Development) explained that learning resource and media are two inseparable terms and designate to the similar object. An object can be claimed to be a media when the object is functionalized, while the learning resource is the object itself [1]. Learning media is a tool used to provide the stimulation so that can stimululate the students’ attention, interest, thoughts, and feelings in achieving learning objectives [2].

Based on the results of interviews conducted with one of mathematics teacher in SMA Negeri 8 Kota Cirebon, students are less motivated for doing mathematics learning activities in schools and students tend to be more interested in reading books that have many pictures compared to textbooks. One of the books that have many pictures is the comic. Learning media that will be developed is a type of printed media in book form. To make the media will be done using the software "Manga Studio", it is a particular software to create an interesting image for making a comic. It is in line with Song claimed that comic can be used as a powerful learning material for interpreting knowledge and application of science [3].

Bloom argued that the ability to understand and comprehend something will be had after knowing or remembering and interpreting the meaning of the material being lesson studied [4]. Mathematical comprehension requires students to communicate the concepts that can be understood by themselves. The indicator of students' mathematical comprehension which is used as the reference is the ability of students' mathematical comprehension based on NCTM, those are the abilities to reiterate the concept that has been studied, to clarify the objects based on whether fulfilled or not the requirements that form
the concept, to apply the concept algorithm, to give the example from the study concepts, to present the concepts in various forms of the mathematics representation, to link the various concepts (internal and external of mathematics), and to develop sufficient terms and conditions adequately from the concepts [5].

Many students have difficulty in achieving an indicator of mathematical comprehension. Based on the results of the test about students' mathematical comprehension in class XI SMA Negeri 8 Kota Cirebon on the lesson of the linear program showed that students' abilities are still low. Many students have difficulty to solve the problems. Some students who are less able to solve the problems have difficulty in the initial steps of completion, so the students are confused in the next steps to complete. In the learning process still often gets an obstacle to solving the problems, especially in story question. The Linear program is one of the mathematics lessons that contains many mathematical problems in story form.

Based on that analysis, it is necessary to develop learning media such as educational comics that can improve the students' mathematical comprehension of linear program material. Therefore, the researcher brings up the title "Development of teaching materials in the linear program of class XI". The purposes of the research conducted as follows: (1) to know the development of educational comic to improve students' understanding of the linear program in Senior High School for XI Grade, (2) educational comic can be said to improve the ability of students' understanding on linear program in Senior High School for XI Grade, (3) to find out students' response in learning by using educational comic media.

2. Method
The research method used is the development of R & D (Research and Development). This is because R & D is an industry-based development method where research findings are used to design product and new procedure [6]. While the development design used is the development model ADD (Analysis, Design, and Development). The selection of this ADD study design is based on the consideration that this design has systematic stages. Related to Tegeh and Kirna said that "this design is structured programmatically with systematic sequences of the activities in the effort to solve learning problems related to the learning resources in accordance with the needs and characteristics of learning itself" [7].

2.1. Research Subject
Subjects in this study are the experts and students of class XI in SMA Negeri 8 Cirebon. Three media experts consist of 2 lecturers who are mastery in media and comic artist. While three lesson experts consist of 1 lecturer who is expert in mathematics field, especially in linear program materials and 2 mathematics teachers of class XI in SMA Negeri 8 Cirebon.

2.2. Instruments of the Study
a. Matematical Comprehension
   Mathematical Comprehension is used to determine the level of students' comprehension of linear program material. The results of the test will be used to analyze and identify the needs in the analysis phase.

b. Interview
   An Interview is conducted to find out the needs in making educational comic media. On the other hands, from that interview also had known the teacher’s opinion about learning in linear program material.

c. Educational Comic Validation Sheet
   The purpose of this validation sheet is to find out the validity of the educational comic media that has been developed. The validation sheet is given to 6 experts that consist of 3 media expert validators and 3 lesson expert validators.

d. Student Response Questionnaire Analysis
   The purpose of this questionnaire is to determine the response of students in learning mathematics using educational comic media.
2.3. A Technique of Data Analysis

a. Analysis of Comic Education Development

A Technique of data analysis on educational comic media development aims to find out the learning difficulties experienced by students, the competencies that must be achieved during the learning, and learning objectives on the linear program materials for educational comics created. Data analysis performed using data reduction techniques based the test results of test questions and interview with teachers at school.

b. Analysis of Comic Education Validation

A Technique of data analysis on educational comic media validation is aimed to know the quality of educational comic media that has been developed. Validation from educational comic media is analyzed by data analysis of validity and based on data obtained from the assessment of media experts and material experts. Validation criteria of educational comic media are presented in Table 1 below: [1]

| Validity Criteria | Rate of Validity |
|-------------------|------------------|
| 85,00 % < V ≤ 100 % | Very valid or usable without revision. |
| 70,00 % < V ≤ 85,00 % | Valid or usable but needs a few revision. |
| 50,00 % < V ≤ 70,00 % | Less valid or recommended is not used because it needs major revisions. |
| 01,00 % < V ≤ 50,00 % | Invalid or unusable. |

c. Student Response Questionnaire Analysis

A Technique of data analysis at students’ response questionnaire that is aimed to find out students’ response to learning using media comic education. Students’ response criteria are presented in Table 2 below: [8]

| Criteria | Interpretation |
|----------|----------------|
| 0% ≤ P ≤ 20% | Very Weak |
| 20% < P ≤ 40% | Weak |
| 40% < P ≤ 60% | Enough |
| 60% < P ≤ 80% | Strong |
| 80% < P ≤ 100% | Very strong |

3. Result and Discussion

3.1. Development of Educational Comic Media

Development of educational comic media conducted by researchers using ADD learning design (Analysis, Design, and Development) has the result which is in line with the analysis stage showed that the students are still weak in their mathematical comprehension on the linear program material. Based on the results of the analysis on student answers, found many mistakes in changing the concept into the form of mathematical representation and students also have not been able to solve the problem algorithm. The students are said to have understood if able to recognize, explain, and interpret a problem [9]. In addition, many students also can not be able to classify the objects based on whether fulfilled or not the requirements that form the concept and develop the necessary and sufficient requirements from the concept. It happens because the students only memorize the completion way of the previous problem without understanding the intent of the settlement itself so that students have difficulties when given new problems. In addition, based on Handayani stated that the ability of students’ mathematical comprehension is still low because students in Indonesia are still dominant an ability to memorize [10].

The result of the interview with mathematics teachers in SMA Negeri 8 Kota Cirebon also showed, there are still many students who consider that the mathematics lesson is difficult. On the other hands,
teaching and learning media in a printed form used by teachers is still limited and has not been able to attract students’ responses in learning. This is in line with the opinion of Prasetio and Fiantika said that the educational comic media in learning is able to make students are motivated to learn math so it will also influence for learning result [11]. After knowing the students’ needs on linear program materials from the analysis phase, then the next stage is planning the development of learning media in the form of print media that is able to attract students’ responses in learning. This educational comic aims to improve students' mathematical comprehension skills which are known still low on linear program material.

The next phase is the development stage itself. In this phase, educational comic to improve students' mathematical comprehension on linear program materials are printed in booklet form. Here are the pictures of comics that have been developed:

![Figure 1. A Lesson in Comics](image1)

![Figure 2. Exercise in Comic](image2)

Then the comic is validated by 6 experts, namely experts that consist of 3 media experts and 3 material experts. The media experts are 2 lecturers of Mathematics Department of FKIP Unswagati and 1 student of Ahmad Dahlan University. While the selected material experts are 1 lecturer of Mathematics Department of FKIP Unswagati and 2 mathematics teachers in SMA Negeri 8 Kota Cirebon. After finding results of educational media comic validation conducted by experts, then it is given to the students to find out the response of students in learning using educational comic media. Responses given by the students through a questionnaire response, is a means of knowing the opinions of students about the deficiencies and advantages of educational comic media for the learning process.

Based on the results of the research, educational comic media that has been developed, it has been suitable with the aim that want to be achieved. This educational comic can be an interesting print media. The one of the benefits or usefulness of learning media is able to improve the quality of student learning outcomes and make the learning process becomes more clear and interesting [12]. Educational comic created by researchers can be used in general, not only for students of class XI in SMA Negeri 8 Kota Cirebon but also for Class XI students from other schools can learn linear program materials using this educational comics media.
3.2. Educational Comic Media Validation

Assessment given by the validators is continued to be analyzed using an analysis adopted from Akbar [1]. Validation analysis conducted on educational comic media is a process of assessment to know the comic education is valid or not, so it is known the feasibility of the educational comic to be used in the learning process. Assessment of validators to educational comic media developed by the researchers is analyzed through 3 stages, those are calculation phase validation every aspect, validation calculation phase every validators and calculation phase validation from whole validators.

Validation analysis of every aspect is done to find out the value along with validation interpretation from every aspect of educational comic media. The results of validation analysis of each aspect showed excellent results, it is shown from the range of values in each aspect between 85 to 88 which has very high validity criteria. Here is the average value of each aspect of the material aspect of 86%, the language aspect of 87%, the presentation aspect of 88%, and the overall display aspect of 85%. This showed the balance of judgments given by the validators, thus it made the average value of each aspect is also equally well balanced.

The second analysis is validation analysis of each validator. Based on the results of validity test on educational comic media, it can be seen that three validators give very good result those are in very valid criteria. While another three validators provided the results only revolve around valid criteria. Here are the details of the results of each validator is the expert validator 1 as a media expert with a percentage of 92%, expert 2 validator as a media expert with a percentage of 95.0%, expert validator 3 as a media expert with a percentage of 76%, expert validator 4 as a material expert with percentage 97%, expert validator 5 as a material expert with a percentage of 78%, and expert validator 6 as a material expert with a percentage of 82%. There are three validators who gave a lower percentage than another three validators, but the assessment is still categorized valid criteria by requiring a few revision.

The last analysis is the analysis of the entire validators. This analysis is done by combining the overall calculation results of each validator divided by the number of validators, so it will be obtained a result of 86.7% which is in very valid criteria. This means that the educational comic media is very valid so it can be implemented without any revision.

Based on the results of validation assessment by the six experts can be concluded that educational comic media to improve the ability of mathematical comprehension on linear program material has a very valid rate, with a percentage of 86.7%. This indicates that the educational comic is suitable to be used in the learning process in the classroom that will be applied in the implementation stage without any revision.

3.3. Student Response to Learning Using Media Comic Education

The data result of the calculation of students’ response on the educational comic media aims to find out the student's response to the learning using educational comic media that has been developed by the researcher. Data analysis will be divided into two stages, namely analysis of students’ response data for each statement and analysis of students’ response data as a whole.

Data Analysis of students’ response to each statement of students’ responses conducted to determine the percentage and interpretation of students' response scores of each response statement is contained in the students’ response questionnaire. The result of data analysis of students’ response indicated that students of class XI IA 3 SMA Negeri 8 Kota Cirebon have a good response to every statement for learning using media comic education. This is shown from the average percentage obtained in each statement that students have a good response to learning using educational comic media. Here is the result of analysis of students’ response data on each statement:
Diagram 1. Results of Student Response Data Analysis of each Statement

The next is an analysis of the overall statements in the questionnaire of students’ responses. This analysis is done by making an average percentage of the total percentage earned by students. Based on the criteria of the students’ response score, the calculation obtained is $P_{\text{combination}} = 76\%$ that is included in strong criteria. So it can be concluded that the students of class XI IA 3 SMA Negeri 8 Kota Cirebon are categorized having a response to the learning using educational comic media with strong criteria. It means students have a good response to the learning conducted using educational comic media. This is indicated by a change in attitude when students follow the learning in the classroom. Students are more active and have an interest because learning activity using educational comics is a new way of learning for students. According to Sudjana and Rivai argued that one of the uses of learning media for students is the method used in learning to be more innovation [13]. So that students always feel curious and not saturated in teaching and learning activity. This is what makes the students’ response very well in learning using educational comic media.

4. Conclusion

The development of educational comic media has been adapted to the competencies (such as Main Competences/KI, Basic Competences/KD, learning indicators and learning objectives) that will be achieved by the students. The exercises used in educational comic media have been adapted to the mathematical comprehension indicator. Based on the development that has been done, educational comic media developed has been suitable with the aim that is to be achieved. Because this educational comic media can be an interesting print media in learning mathematics. Educational comic media can be used generally for students who want to learn linear course material. Based on the results of validation assessment by the six validators it can be concluded that educational comic media to improve the ability of mathematical comprehension in linear program material has a valid validity level, with a percentage of 86.7%. This indicates that the media is worth using without any revision. Based on the criteria of students’ response scores, the calculation obtained is $P_{\text{combination}} = 76\%$ included in strong criteria. So it can be concluded that the students of class XI IA 3 SMA Negeri 8 Kota Cirebon is categorized having a good response to the learning using educational comic media with strong criteria.

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