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Development of handout teaching materials with a contextual approach to improve students' mathematical understanding

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Abstract: *This study aims to determine which handout teaching materials with a contextual approach are suitable for use in learning mathematics, and to find out that handout teaching materials with a contextual approach are able to improve students' mathematical understanding. The type of research used is Research and Development (R&D) using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The data collected in the form of observation sheets, interviews, questionnaires, and tests of students' mathematical understanding. The handout validation was validated by experts, namely material, language, and media experts, covering aspects of content, presentation, language, and graphics. In the validation results, material experts get a score of 3.44 which states "very valid", the linguist gets a score of 3.69 which states "very valid", and media experts get a score of 3.21 which states "valid". so that the overall average score gets a value of 3.45 which states "very valid". While the student and teacher responses get an average score of 3.25 which states "very practical", and on the effectiveness of the handout teaching materials obtained from the final test results students get a percentage of 71.8% which states "effective". Then on the results of the students' understanding test, they got an n-gain value of 0.6 which stated "medium", that the understanding obtained by students did not decrease or increase so it was relatively moderate.*

Keywords: *Handout, Contextual approach, Mathematical understanding*

A. Introduction

Self-development for teachers is very important to hone self-development skills that are not only in the physical aspect but can be in the form of non-physical aspects such as attitudes, professionalism, and ways of teaching (Prastowo, 2015, hal. 13). So that in its implementation there is a need for innovation in learning that helps students absorb the content in the learning material.

Moreover, education from time to time has progressed rapidly, so that educational facilities and infrastructure are increasingly sophisticated, as well as changes that occur in society causing the advancement of the world of education, with this rapid rate of development causing the problems faced by teachers to increase (Wijayanto & Santoso, 2018, hal. 96). To overcome this, it is necessary to have appropriate learning processing.

Therefore, the use of media in learning is very helpful for teachers in making learning effective and delivering messages as well as the content of the subject matter (Uyun, Holisin,

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& Kristianti, 2017, hal. 116). That way the media really needs to be used in learning so that learning is efficient.

Because learning media is a form of means of delivering information that is made or used in accordance with learning theory, it can be used for learning purposes in conveying messages, stimulating students' thoughts, feelings, attention, and willingness so that it can encourage a deliberate, purposeful, and controlled learning process (Suryani, Setiawan, & Putria, 2018, hal. 3). Mathematics learning in junior high school which is still dominated by conventional learning in which students are placed as objects of learning, or also learning that is still interactive *teacher centered* (Fitri & Octarini , 2017, hal. 87). The function of the teacher as the center of attention of students in learning, causes students to focus on listening to what is conveyed by the teacher.

On the other hand, the low learning achievement of students is caused by several factors such as the lack of variety in the learning methods used, the ineffective learning methods or teaching materials used, and mathematics learning that is less associated with culture or everyday phenomena, causing students to say that mathematics is difficult (Fauziah & Wahid, 2021, hal. 64).

Based on the results of the PISA (*Program for International Student Assessment*) organized by the *Organization for Economic Cooperation and Development* (*OECD*) or the organization for economic cooperation and development in 2009 that Indonesian students' mathematical abilities are still low, as evidenced by Indonesian students who have low mathematical literacy skills (below level 2) reached 76.6%. The definition of low here according to the OECD is below the minimum literacy standard of a person to function effectively in 21st century life. This shows that almost 80% of students will not be ready to function effectively in this modern life. (Jusniani, 2018, hal. 83-84).

One of the factors that causes the low ability of students to understand concepts is mathematics learning which has been conveyed to students in an informative manner (Haqq, 2016, p. 70). So that students are lazy to think critically about their knowledge which causes them to only acquire and not apply their knowledge.

According to Arcat (2017) every teacher should be able to design learning that links the context of students' lives with the subject matter so that students are able to build new insights based on the knowledge that they previously had on a daily basis (Makur, Nendi, & Brinus, 2019, hal. 264). In essence, science is more meaningful when students can relate their knowledge to the surrounding environment.

Moreover, mathematics will be more fun if the teaching materials are developed to include material related to real contexts in everyday life (Suastika & Rahmawati, 2019, hal. 58). Moreover, with contextual teaching materials, students will build more knowledge, as well as the learning that is carried out, so that they are not focused on the teacher alone.

By posing contextual problems, students are gradually guided to master mathematical concepts. Contextual problems used in learning are expected to make students not feel abstract about mathematical problems, because things that start from reality and are close to life situations in the student's environment will be easier to understand (Siswandi, Sujadi, & Riyadi, 2016, hal. 633-634). Learning with *teacher centered* can cause teachers to fall behind in the evaluation of learning, because the learning can take more time than the planned meeting, which is caused by students who still do not understand the material being taught. So the teacher must repeat the material being taught.

However, if the teacher can process learning well, then the teacher does not need to repeat the lesson. Therefore, it is necessary to have teaching materials such as *handouts* that are

appropriate to the problem, because the *handouts* here are an important subject in the material presented by the teacher before learning begins, and students can re-learn the lessons that have been given by the teacher with these *handouts* .

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On the other hand , students can find out how big the impact of mathematics is in their lives, not only social sciences that exist in the environment, mathematics too. They can also find concepts and interpret from the context of the problem into mathematics to find formulas, which makes mathematics not only monotonous in mere formulas, but can be processed in the form of a real context.

B. Methods

The type of research used by the researcher is the type of research *and development (* R&D). According to Borg and Gell (1988) in stating that research and development is a research method used to develop and also validate products used to support education and learning (Sugiyono, 2015, hal. 9).

The model in the development used is the ADDIE model *(analysis, design, development, implementation, and evaluation)* , this model is used to support the success and feasibility of teaching materials so that they can be used to assist students in learning as well as student learning resources. Referring to the design of the ADDIE model, the (Suryani, Setiawan, & Putria, 2018) activities in this study can be explained as follows:

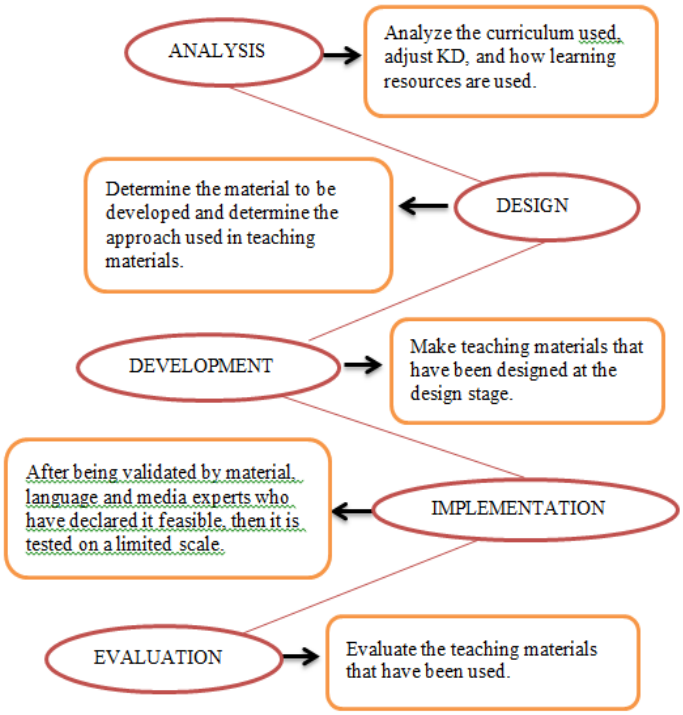


Figure 1. ADDIE Research Procedure

This product trial uses the Pretest -*Posttest Only Group Design.* Look at the table below (Azwa, 2018, hal. 164):

Table 1. Research Design

Group	Randomization	Pretest	Treatment	Postes
VII B	√	O1	√	O2

VII B = Experimental group
O = Measurement of the dependent variable

In this study, the researcher chose the instrument used in the form of a questionnaire from media experts, linguists and material experts to show whether the handout teaching materials were suitable for use or not, and also a written test in the form of description questions to measure the ability of mathematical understanding of the set material.

Data analysis techniques were used to determine the validity of the handout teaching materials by using a contextual approach to the circle material. According to Sugiyono (2017: 134-135) in saying that the Likert scale used has four categories of answers, which are shown in the table below :

Table 2. Likert Scale Score

Answer Category	Question Score
SB	4
B	3
TB	2
STB	1

The validation results from all validators are then presented in tabular form. After that, find the average score using the following formula (Selvi, 2018, hal. 5):

$$x = \frac{\sum x}{N}$$

Description :

x = Average value
$\sum x$ = Number of data values
N = Number of data

From the average score of the validator results obtained to determine whether the handouts made are valid or not, it can be adjusted using the categories in the table below :

Table 3. Teaching Material Validation Score

Average	Category
3.25 - 4.00	Very Valid
2.50 - 3.24	Valid
1.75 - 2.49	Invalid
1.00 - 1.74	Very Invalid

The following items score for the *pretest* and *posttest questions* that use the form of an objective description (Baskoro, 2019, hal. 122)in knowing students' mathematical understanding, see the table below :

Table 4. Pretest And Posttest Answer Scores

Answer Category	Question Score

Every keyword is correct	1
Every wrong keyword	0

After getting a score on the acquisition of *pretest* and *posttest* then processed the results of the answers with the formula below (Anggraini, Murni, & Susanti, 2014, hal. 6):

$$\text{N} - gain = \frac{skor\ post\ test - skor\ pretest}{skor\ total\ ideal - skor\ pretest}$$

The results of calculations on the average N-gain in students' mathematical understanding abilities are then processed and interpreted using the classification from Rostina Sundayana (2014) which is modified from the classification according to Hake according to the table below:

Table 5. Student's Mathematical Understanding Score

N value – *gain* (g)	**Classification**
-1.00 g < 0.00	There is a decrease
g = 0.00	No Increase
0.00 < g < 0.30	Low
0.30 g < 0.70	Currently
0.70 g 1.00	Tall

C. Findings and Discussion

The development of the handout refers to another researcher, namely Dadang Adie Tiya in 2017 who uses the ADDIE model, according to some researchers the procedures used can facilitate other researchers in the development process. The ADDIE model includes several stages, namely Analysis, Design, Development, Implementation, and Evaluation. The following procedures or stages of development using the ADDIE model:

Analysis

a. Curriculum Analysis

In the initial analysis process, the researcher made observations about the curriculum used at SMP N 5 Tanjung, based on interviews obtained by the researcher from the mathematics teacher at SMP N 5 Tanjung, namely Mr. M. Adi Sofyan, S.Pd that the curriculum used was the 2013 revised edition of the curriculum.

a. KD Adjustment

In the number material there are 3 basic competencies (KD), the set material has 1 basic competence (KD), the algebraic form material has 2 basic competencies (KD), while in linear equations and inequalities one variable 1 basic competence (KD).

b. Learning Resources used

Based on the results of interviews about the learning resources used, it was found that the learning resources used were in the form of worksheets made by the MGMP (Subject Teacher Conference) Kab. Brebes. However, these worksheets have not achieved optimal results because only certain students have them. caused by the lack of awareness of students in the importance of learning is less motivating.

Design

a. Determining the Material to be Developed

The material used in preparing the handout teaching materials is the set material by looking at the situation and conditions at the KD adjustment analysis stage, the learning numbers material is carried out at the beginning of the new academic year in July to August, while the set material is carried out in August to September before PTS, namely in late September, so the researchers chose the middle material before doing PTS. the set material is also very suitable by

using a contextual approach in which every KD learning is always involved with the learning material.

b. Approach used in Teaching Materials

The approach used in the handout teaching materials is a contextual approach, because the contextual approach can involve students in learning in everyday life, thus creating a new atmosphere and motivating student learning.

Development

a. Making Teaching Materials

1) KD and learning indicators are presented at the beginning of the discussion using font 10, each sub- chapter begins with the concept of a contextual approach that can train an understanding of the animal world. Likewise, in the *header section* , straight lines and pictures are made so that the *handout* is not too monotonous.
2) The set chapter material is divided into four sub-chapters equipped with examples and exercises, with each title, sample questions and practice questions in the *handout* using *shapes* to clarify concepts.
3) The “let's see” and “let's match” lettering sections use *WordArt.* Researchers also use *text boxes* in the matching section by combining them with tables. Icons on *the chart* are used to make it easier to distinguish the presentation of the set.
4) pictures in the *handouts are* displayed to attract students' attention in seeing animals in everyday life, because pictures can attract students' interest in reading in learning activities.
5) In the *handout* there is a *cover* , introduction, table of contents, and bibliography.

b. Expert Validation

The following table of average scores by all experts:

Table 6. Expert Overall Average Score

Expert Expert Validation	Average Score	Criteria
Material Expert	3.44	Very Valid
Linguist	3.69	Very Valid
Media Expert	3.21	Valid
Total Average Score	**3.45**	**Very Valid**

Based on the conclusions obtained from all the experts, the score was 3.45 which stated the handout was "very valid" so that it was suitable for use in the field and could be tested on students.

With the handout teaching materials suitable for use with revisions, even comments from material experts say that important points are given highlights that show important topics. As well as teaching materials are revised with more interesting presentations and presented so that students can be active in the handouts.

Comments by linguists are many ambiguous words that are not in accordance with Indonesian language rules, and punctuation marks that are still not in accordance with linguistic rules. And the last comments from media experts say that examples of animals must be in the environment, .for animals that are in zoos, not those around us. Connecting words are not right and the writing is uneven to the right, as well as explanations and illustrations are still wrong.

Implementation

1. Limited Scale Test

Based on the results of the students' test scores before and after the implementation of the handout , it was stated that the average score obtained was 0.6 which stated that the increase in students' mathematical understanding that occurred before and after was "medium".

While based on the results of the student test followed by 28 students, stating that the student's score above 70 was 18 students, and the average score obtained from the test results was 71.8% which stated that the "effective" handout was used by students. Although the completeness expected by the researcher should be complete, the student learning outcomes during the research are obtained as they are. The following table shows the average score of teacher and student questionnaires:

Table 7. The Average Score Of The Questionnaire

Data	Score
Teacher	3.5
Student	3
Average	**3.25**
Criteria	**Very Practical**

Based on the results of the overall teacher and student response questionnaire, it resulted in a score of 3.25 which stated that the handout was "very practical" which made students very interested in learning and made students enthusiastic about learning.

Evaluation

The following is the improvement of the handout teaching materials after being used in the field:

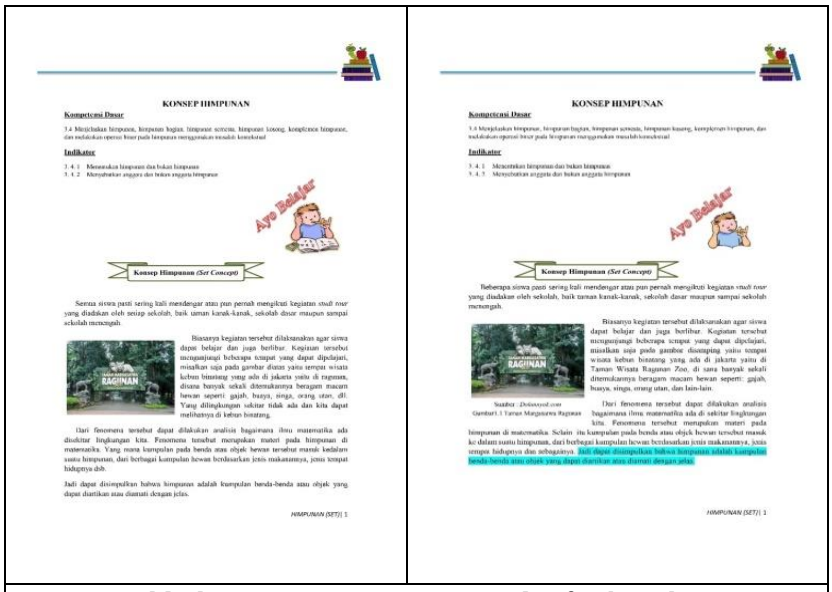
1. Changes to the Front Cover

In the title "Contextual Approach Handout" the font type must be equated with the title "Material set" and the level which is only for SMP is replaced for SMP/MTs

Figure 2. Changes Cover

According to experts, the type of font in the title and writing in the handout teaching materials must be generalized, and at the level level it must be generalized as well, not only at SMP but also to be used for MTs level as well.

2. Changes to Highlighting Important Subjects

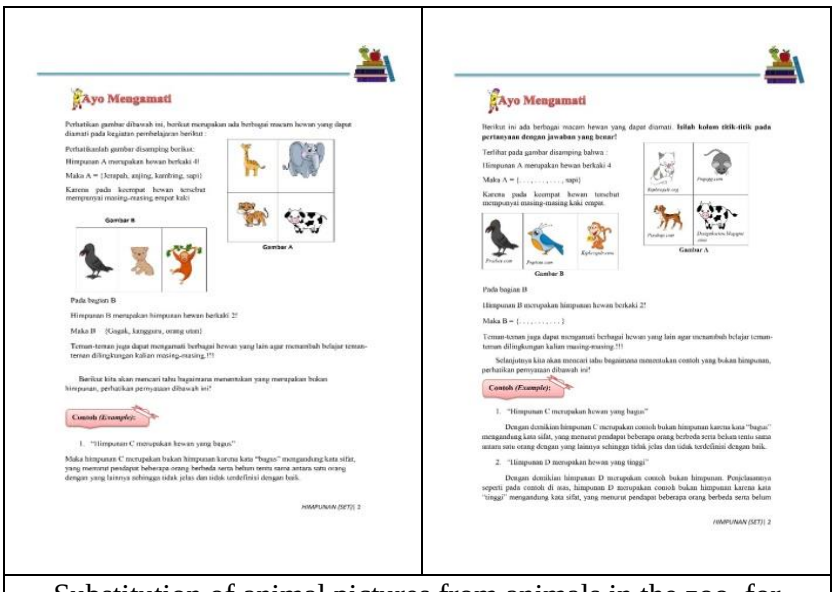


Highlighting important points to clarify *the* subject

Figure 3. Highlighting

Giving a highlight on the handout to find out that the writing is an important subject matter, as well as material that must be really paid attention to again, as well as making it easier for students to find important points in the handout. Moreover, in the initial perception, students find a contextual approach that includes various kinds of animals in the zoo.

3. Example Changes in Set Concepts



Substitution of animal pictures from animals in the zoo, for example: giraffe, kangaroo, elephant. Replaced with animals that are around the house.

Figure 4. Change The Image In The Sample Questions

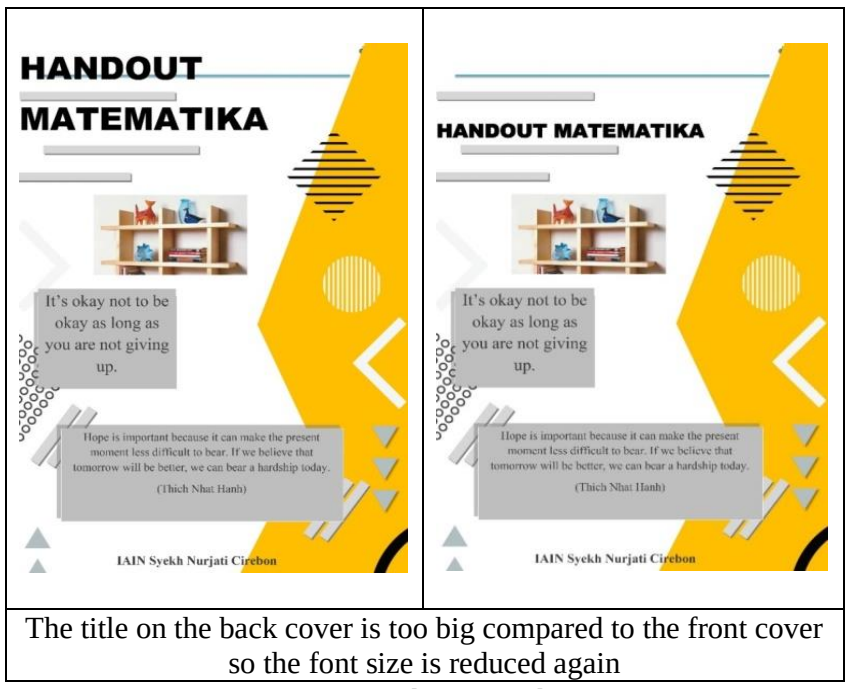
According to experts, there are several animals such as giraffes, kangaroos, elephants, which are very difficult to find around the house, so animal pictures must adapt to a contextual approach that connects with animals in our environment that are easy to see, making it easier for students to learn.

4. Example Changes to Association Members

Changed the image because the initial image was not very clear, so it was replaced with a clearer animal image

Figure 5. Image Change

5. Back Cover Change



The title on the back cover is too big compared to the front cover so the font size is reduced again

Figure 6. Back Cover Change

On the back cover the writing on the title is too big, so the size is reduced again, because between the front and back cover the font size must be smaller than the front. therefore the font size is reduced.

Discussion

Learning to use worksheets as a learning resource is the teacher's way to make learning effective, but in its implementation the worksheets have not reached the desired target because not all students have them. Even with affordable prices, student awareness has not led to achieving maximum learning. Based on the initial observations obtained by the researchers that learning mathematics at SMP N 5 Tanjung is not good or not optimal in its implementation, the cause of the learning being not maximal according to the mathematics subject teacher, that students are not actively involved in learning and the main factor is lack of motivation student learning. Therefore, researchers develop teaching materials in the form of handouts with a contextual approach so that students can focus on teaching materials with the scope of everyday life, so that they can learn about various kinds of animal life that can be understood, not only learning about natural sciences but also associated with mathematics.

The first procedure is Analysis. Researchers analyzed the curriculum, KD adjustments and learning resources used in schools. From some of these things, it is obtained as follows: the curriculum used at SMP N 5 Tanjung is in the form of a revised 2013 curriculum edition with 4 chapters of material such as numbers, sets, algebraic forms and linear equations and inequalities of one variable. Meanwhile, the learning resources used in schools are student worksheets, but the resulting learning has not achieved maximum results, because the student worksheets used by students are not evenly distributed. Lack of awareness of students in learning, even though the worksheets used are needed for the benefit of student learning, so that student literacy lacks interest in learning mathematics, student worksheets are rarely used for independent study. Therefore, the researcher made handout teaching materials that presented a summary of the main material presented by the teacher before learning, as well as examples of questions and practice questions that were presented according to the material presented.

The second procedure is design, this process includes determining the material to be developed and the approach used in teaching materials. In the process of determining the material to be developed in the form of set material, because the set material is material that is suitable for adjusting the learning time in the middle before PTS at the analysis stage after the initial chapter, namely the number material. While the approach process used in teaching materials is using a contextual approach because the contextual approach can make students learn and understand what is around them. After that, the researcher made a design design for making handout teaching materials which would later be developed in the next stage.

The following is the process of making the developed teaching materials:

(a) KD and learning indicators are presented at the beginning of the discussion using font 10, each sub-chapter of learning material begins with the concept of a contextual approach that can train understanding about the animal world. In the header section, a straight line is made and the addition of images so that the handout is not too monotonous, the color selection is also adjusted to all genders. The letters in the handout use the Times New Roman font, with a size of 12, and the writing is aligned right and left using justify. However, in the title of each sub-chapter the font size is different, namely 14.

(b) The set chapter material is divided into four sub-chapters equipped with sample questions and practice questions, with each title, sample questions and practice questions in the handout designed using shape icons to clarify each title. In the sub-chapter the concept of the set contains the kinds of animals which are then grouped into a set of animals. The second sub-chapter on set notation that relates to food in animals is then presented in association-forming notation. The third sub-chapter on the properties of sets uses the context of the life of various flying animals and then presents them in the set of cardinality, part, power, and similarity of the two sets. And the last part of the sub-chapter on set operations connects reproduction, life in animals that can live in two realms, then presented in slices, combinations, complements and differences in the set.

(c) Part of the letters “let's observe” and “let's match” using WordArt. Researchers also use text boxes in the matching section by combining them with tables. Icons on the chart are

used to make it easier to distinguish the presentation of the set. In the properties of the set, the researcher summarizes the material into a concept map chart to see the differences between the four properties in the set. There is a section where students require to fill in matching questions with the correct answers and can be done in groups with their groups.

(d) The pictures in the handouts are displayed to attract students' attention in seeing animals in everyday life, because pictures can attract students' reading interest in learning activities. The use of some of the pictures in the handout about the surrounding environment to motivate students' interest in learning. In each discussion of the material after that, there are sample questions and their explanations, which are then modified by using the dots section, by requiring students to fill in the dotted sections, this section serves to train students' focus in class, and can practice activeness in working on questions.

(e) In the handout there is a cover, introduction, table of contents, and bibliography. There is a cover, an introduction, a table of contents, the material is divided into four sub-chapters, sample questions are available in each discussion title, and practice questions are at the end after the material is finished. In the assessment of the material experts, the aspects assessed are in the form of content aspects and presentation aspects. In the presentation aspect, there are several criteria, which include the suitability of the material to KD, the accuracy of the material, supporting learning materials and contextual characteristics. Meanwhile, in the aspect of presentation, the criteria assessed are presentation techniques and presentation support. The aspects of language assessed are straightforward, communicative, dialogical and interactive, conformity to the level of development of students, coherence and integration of the flow of thought, use of the term symbol or icon. Meanwhile, in the media aspect, the criteria assessed are handout size, handout cover design and handout content design.

In the fourth stage, namely the implementation stage, in this process the researchers conducted a limited-scale test on 28 grade VII B students of SMP N 5 Tanjung by conducting pretests and posttests on the scores of students' mathematical understanding test results before using the handout teaching materials and after using the handout teaching materials. Then the students' final test scores are used to see the effectiveness of the handout teaching materials that have been used during the learning process. The test indicators are indicators of understanding about restating a concept, classifying objects according to certain properties according to the concept, and using, utilizing and selecting certain procedures/operations.

In the last stage, namely the evaluation process, this process evaluates teaching materials that have been validated by experts, the process is repaired according to the direction of the experts, the changes made are: changes to the front cover, changes to highlighting on important topics, changes to examples and pictures on the concept of the set, changes in examples and pictures on the members of the set, changes in the back cover.

D. Conclusion

Handout teaching materials developed were declared to be very valid, and suitable for use in the field with the acquisition of scores from material experts getting an average score of 3.44 which was said to be "very valid", and linguists getting an average score of 3.69 which said " very valid", and media experts got an average score of 3.21 which was said to be "valid". After that, the data was used as an overall average, by material, language, and media experts getting an overall score of 3.45. Which includes aspects of presentation, aspects of feasibility, and aspects of language.

Based on the *pretest* and *posttest scores* obtained, the students got a gain of 0.6 which stated that the students' understanding obtained did not decrease or increase during learning using *handouts* . As well as the results of the questionnaire responses of teachers and students get an average score of 3.25 which states the *handout* is "very practical", while in the final test results students get a percentage score of 71.8% which states the *handout is* "effective".

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