Developing Group Investigation Based Student Worksheets

Zulyadaini[1], Martinis Yamin[2*]
[1]Lecturer for FKIP,
Batanghari University in Jambi-Indonesia.
[2] Lecturer for FITK,
The State Institute for Islamic Studies in Jambi-Indonesia.
martinisyamin@yahoo.co.id

*Corresponding Author

Abstract-*The purposes of this research are to describe the development of Group Investigation Based Student Worksheets on Similarity and Congruence for the 9th Grade Students, as well as to find out the quality of Student Worksheets developed based on the aspects of validity and practicality. It is a Research and Development (R&D), with the findings as follows; (1) the validation conducted by the material experts obtained the percentage of feasibility of 82%, (2) the validation conducted by the design experts obtained the percentage of feasibility of 77,9%, (3) the validation conducted by the media experts obtained the percentage of feasibility is 94,29%, (4) the students' responses on the individual test obtained the percentage of feasibility of 95,03%, which is categorized very feasible, (5) the students' responses on the small-group test obtained the percentage of feasibility of 79,2%, which is categorized very feasible, (6) the students' responses on the large-group test obtained the percentage of feasibility of 79,2%. Based on the data analysis obtained from the assessment on the Student Worksheets conducted by some experts (material, design, and media) and based on the data of students' response obtained from the product testing, it can be concluded that the developed Student Worksheets meet the validity and practicality criteria.*

Keywords- Group Investigation; Similarity; Congruence; Student Worksheets Quality

1. INTRODUCTION

Government Regulation Number 32 of 2013 concerning National Education Standards, which is a interpretation of Law Number 20 of 2003 concerning National Education System. As stated in the general provisions of Article 1 of Government Regulation Number 32 of 2013, that National Education Standards are the minimum criteria regarding the educational system in the entire territory of the Unitary State of Republic of Indonesia. Government Regulation provides direction on the need for development and implementation of eight standards of national education, they are: content standards, process standards, competence standards, standards for teachers and education personnel, facilities and infrastructure standards, management standards, standards for financing and educational assessment.

The content standards as defined in Government Regulation Number 32 of 2013, include the scope of material and level of competence to achieve certain competence at the graduate level and type of education. There are five scope of materials of mathematics studied in junior high school level, they are; rational number, algebra (introduction), geometry, statistics and probability, as well as the set.

Difficulties experienced by students in learning some of the materials, especially for similarity and congruence because they do not understand the concept of similarity and congruence. Moreover, all this time, the mathematics taught by the teachers regarding similarity and congruence is conducted using direct teaching method and student worksheets purchased through the publisher as the teaching materials. The learning method in which only supported by student worksheets, have not given the freedom to the students to investigate/explore the concept of similarity and congruence by themselves. The student worksheets made by the publishers have already contain complete materials, but the activities within are less facilitating the role of students in learning to discover and understand the concept of the material through the manual instructions in the worksheet activities.

There is an alternative to solve these problems, that is the development on student worksheets in which the activities will be developed to be able to give freedom to the students to investigate/explore what they need to solve the problem they face, so that they will obtain a good learning experience, will be able to understand the concept completely, as well as it helps them to achieve learning objectives. Therefore, the researcher tried to design students worksheets regarding similarity and congruence

in which the activities will have a *group investigation* based concept.

2. RESEARCH METHOD

It is a Research and Development (R&D) research. Research and Development is a set of processes and steps in developing a new product or improving the existing products for accountability. The purpose of Research and Development is to find out, develop, and validate a product. Meanwhile, according to Borg and Gall, cited from *English Educational Journal* (Abdillah, 2013:109)[1], they explain *"research and development as a process used to develop and validate educational product"*.

At the end, Research and Development will result in a product. As in the educational products resulted from the Research and Development, cited from *Unesa Journal of Chemical Education* (Ikhtiarini et al., 2012:86), can be in the form of curriculum specified for particular educational purpose, teaching method, teaching media, educational media, textbook, module, educational personnel competence, evaluation system, competence test model, classroom arrangement for particular learning model, production unit model, management model, employee development system, payroll system, and so on. Group investigation based worksheets

The purpose of group investigation based worksheets is to help the students to find the concepts, to implement and integrate different concepts creatively, and to reinforce deepening and implementing the learning materials.

The cooperative methods involving the in-group project/research, such as group investigation, should have a worksheet containing information about the format of in-group research/project report. In addition, this worksheet should be completed by additional information regarding the reference materials which can be studied by every group to conduct each research/project. (Huda, 2014:185)[12]

The group investigation based student worksheets will be properly implemented if it is supported by an educational environment that has interpersonal communication skills and concerns to the social sense of classroom learning. Students will produce a meaningful learning process to improve the quality of learning process and result for every stage of student activities in which they are actively involved both intellectually and emotionally, interact directly with the learning resources, construct their own knowledge and are required to be able to work together and respect others in group.

Results

The procedures of developing of the group investigation based student worksheets on similarity and congruence for the 9th Grade students have been

conducted refer to the development model of ADDIE which consists of five stages: analysis, design, development, implementation, evaluation. The explanation on development stages is described as follows:

2.1 ANALYSIS

The results of analysis stages conducted in the development are as follows:

a. Curriculum Analysis
   Curriculum Analysis aims at creating the basis for the media development planning in order to be able to provide information regarding similarity and congruence clearly.

b. Students' Characteristics Analysis
   Students Analysis is conducted to find out the characteristics of the 9th Grade Students. The analysis is conducted based on the interview conducted with the mathematics teacher who previously taught the students when they were in the 8th Grade.

c. Material Analysis
   The materials selected to be included in the development of student worksheets are Similarity and Congruence. The worksheets is developed based on the standard of competence and basic competence within the School-Based Curriculum of Mathematics for Junior High School Students.

2.2 DESIGN

The following stage is designing the student worksheets based on the things obtained in the analysis stage.

2.3 DEVELOPMENT

The *development* stage includes the development of draft I worksheets, which has been designed based on the design stage. The activities in the development stage are as follows: developing cover, forewords, standard of competence, manual instructions of the worksheets, title of the worksheets and procedures.

2.4 IMPLEMENTATION

The *implementation* stage on the worksheets has been validated through the test conducted to the 9th Grade Students. The product testing on the implementation stage includes individual test, small-group test, and large-group test.

a. Individual Test
   The draft I worksheets have been revised based on the experts' suggestions, thus it has been stated as valid, resulted in the draft II worksheets which were later tested for individual test. The individual test for the draft II worksheets was conducted to three students who have high, medium, and low skills, respectively.

b. Small-Group Test
   The draft II worksheets have been revised based on the experts' suggestions, thus it has been stated as valid, resulted in the draft III worksheets which were later tested for small-group test. Similar to the individual test, the small-group test was started by gathering 6 students as the sample in an occasion.

c. Large-Group Test
The draft III worksheets were not revised since there was no revision suggestion from the experts on the small-group test. The draft III worksheets were stated as valid based on the result of the small-group test which resulted in the draft worksheets

3. EVALUATION

Evaluation aims at collecting data on every stage which is used to improve the product and to determine the level of quality of the developed product. The data which have been collected from the development and implementation stages are as follows:

a. Material Experts
The assessment or validation on draft I student worksheets from the aspects of materials was carried out by a teacher and a lecturer of mathematics. They assessed the compliance of draft I student worksheets on the components of content feasibility, language and presentation. The following is the diagram of student worksheets assessment carried out by the material experts on each aspect.
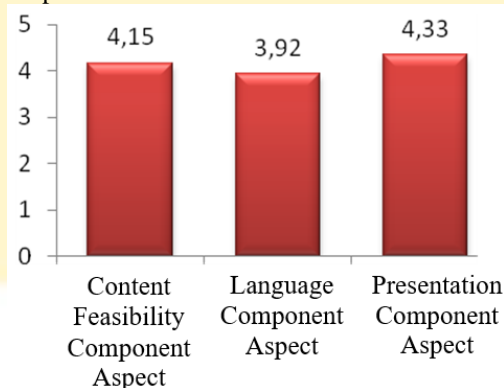
Figure 1. Diagram of Student Worksheet Assessment by the Material Experts on Each Aspect

Overall, the data of draft I student worksheets assessment by the material experts shows that the total average obtained by the experts is $X = 4,13$. If this data is described into qualitative data, based on the assessment criteria (Widoyoko, 2015:238), it is considered as "Good" criteria. The percentage of feasibility of draft I student worksheets from the aspects of material can be obtained by using the formulation by Arikunto (Purbasari, 2012:3) as follow.

$$(\%) = \frac{\sum rata - rata\ skor}{\sum rerata\ skor\ ideal} \times 100$$
$$= \frac{82}{100} \times 100\% = 82\%$$

*rata-rata skor: score average
Rerata skor ideal: ideal score average

From the calculation above, the percentage of feasibility obtained is 82%, if the data is described in the predetermined scoring scale according to Arikunto (Purbasari, 2012:3), it shows that the quality of student

worksheets from the whole aspects is categorized "Very Feasible" from the aspects of material.

b. Media Expert
The assessment or validation on draft I student worksheets from the aspects of media was carried out by a lecturer. The expert assessed the compliance of draft I student worksheets on the display design, layout, illustration/figures/pictures and the use of fonts (types and sizes). The following is the diagram of student worksheets assessment on each aspect.
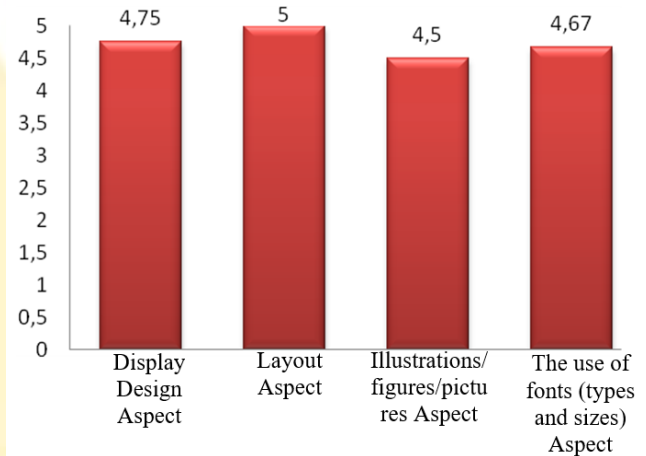
Figure 2: Student worksheets assessment on each aspect

Overall, the data of draft I student worksheets assessment by the media expert shows that the total average obtained by the expert is $X = 4,73$. If this data is described into qualitative data, based on the assessment criteria (Widoyoko, 2014:238)[30], it is considered as "Very Good" criteria. The percentage of feasibility of draft I student worksheets from the aspects of media can be obtained by using the formulation by Arikunto (Purbasari, 2012:3) as follow.

$$(\%) = \frac{\sum jumlah\ rata - rata\ skor}{\sum rerata\ skor\ ideal} \times 100$$
$$= \frac{66}{70} \times 100\% = 94,29\%$$

*rata-rata skor: score average
Rerata skor ideal: ideal score average

From the calculation above, the percentage of feasibility obtained is 94,29%, if the data is described in the predetermined scoring scale according to Arikunto (Purbasari, 2012:3), it shows that the quality of student worksheets from the whole aspects is categorized "Very Feasible" from the aspects of media

c. Design Expert
The validation on draft I student worksheets from the aspects of design was carried out by a lecturer. The expert assessed the compliance of draft I student worksheets on the compliance of the student worksheets towards the display design, layout, compliance of the student worksheets towards the students development, compliance of the student worksheets towards teaching needs and compliance of the group investigation based student

worksheets. The following is the diagram of student worksheets assessment by design expert on each aspect.
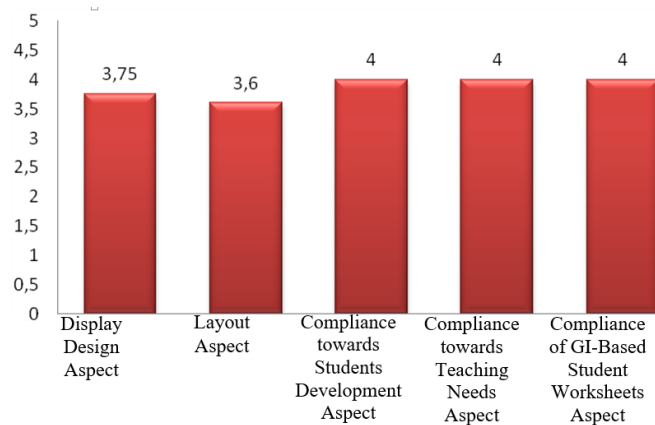
Figure 3. Diagram of Student Worksheet Assessment by the Design Expert on Each Aspect

Overall, the data of draft I student worksheets assessment by the design expert shows that the total average obtained by the expert is $X = 3,87$. If this data is described into qualitative data, based on the assessment criteria (Widoyoko, 2015:238), it is considered as "Good" criteria. The percentage of feasibility of draft I student worksheets from the aspects of design can be obtained by using the formulation by Arikunto (Purbasari, 2012:3) as follow.

$$(\%) = \frac{\sum jumlah\ rata-rata\ skor}{\sum rerata\ skor\ ideal} \times 100$$
$$= \frac{89}{115} \times 100\% = 77,4\%$$

*rata-rata skor: score average
Rerata skor ideal: ideal score average

From the calculation above, the percentage of feasibility obtained is 77,4%, if the data is described in the predetermined scoring scale according to Arikunto (Purbasari, 2012:3), it shows that the quality of student worksheets from the whole aspects is categorized "Very Feasible" from the aspects of design.

d. Individual Test

The individual test aims at finding out the weaknesses on the draft II student worksheets by distributing the questionnaire concerning students' responses. The draft II student worksheets were resulted from the draft I student worksheets which have been previously stated feasible by the experts for further test and have been revised based on the revision suggestions from the experts.

The following is the diagram of students' responses on the individual test based on each aspect.

Overall, the data of students' responses towards the draft II student worksheets in the individual test shows that the average students' responses is $X = 4,75$. If this data is described into qualitative data, based on the assessment criteria (Widoyoko, 2015:238), it is considered as "Very Good" criteria. The percentage of feasibility of draft II student worksheets on the individual test can be obtained by using the formulation by Arikunto (Purbasari, 2012:3) as follow.

$$(\%) = \frac{\sum jumlah\ rata-rata\ skor}{\sum rerata\ skor\ ideal} \times 100$$
$$= \frac{57,02}{60} \times 100\% = 95,03\%$$

*rata-rata skor: score average
Rerata skor ideal: ideal score average

From the calculation above, the percentage of feasibility obtained is 95,03%, if the data is described in the predetermined scoring scale according to Arikunto (Purbasari, 2012:3), it shows that the quality of draft II student worksheets is categorized "Very Feasible" from the whole aspects.

e. Small-Group Test

The small-group test aims at finding out the weaknesses on the draft III student worksheets by distributing the questionnaire concerning students' responses. The following is the diagram of students' responses on the small-group test based on each aspect.
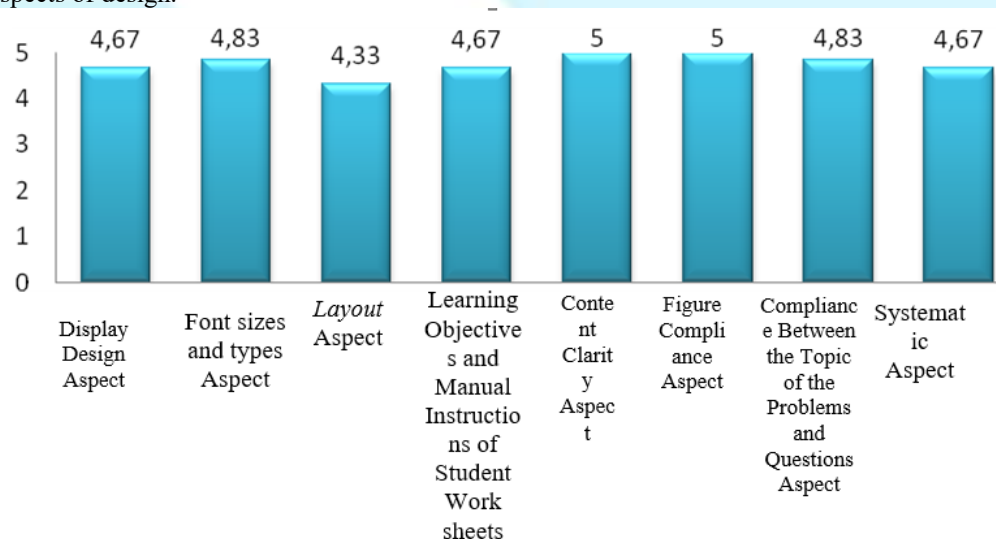
Figure 4. Diagram of Students' Responses on Each Aspect in the Individual Test

Overall, the data of students' responses towards the draft III student worksheets in the small-group test shows that the average students' responses is $X = 4,28$. If this data is described into qualitative data, based on the assessment criteria (Widoyoko, 2015:238), it is considered as "Very Good" criteria. The percentage of feasibility of draft III student worksheets on the individual test can be obtained by using the formulation by Arikunto (Purbasari, 2012:3) as follow.

$$(\%) = \frac{\sum jumlah\ rata-rata\ skor}{\sum rerata\ skor\ ideal} \times 100$$
$$= \frac{55,8}{65} \times 100\% = 85,8\%$$

*rata-rata skor: score average
Rerata skor ideal: ideal score average

From the calculation above, the percentage of feasibility obtained is 85,8%, if the data is described in the predetermined scoring scale according to Arikunto (Purbasari, 2012:3), it shows that the quality of draft III student worksheets is categorized "Very Feasible" from the whole aspects.

f. Large-Group Test

The large-group test aims at finding out the quality of student worksheets from the aspects of practicality through the students' responses on the draft IV student worksheets. The draft IV student worksheets were resulted from the draft III student worksheets which have been previously tested to the students in the small-group test and have obtained very good responses, so that were feasible to be tested on the real classroom test.
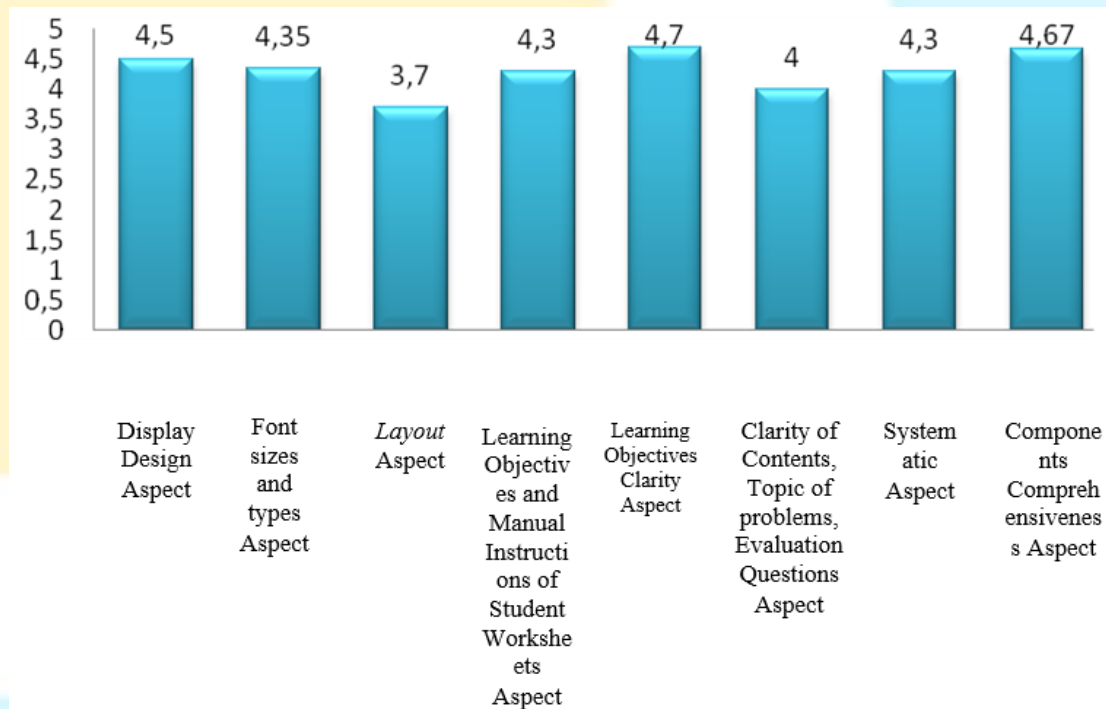

Figure 5. Diagram of Students' Responses on Each Aspect in the Small-Group Test

Overall, the data of students' responses towards the draft IV student worksheets in the large-group test shows that the total average students' responses is $X = 3,92$. If this data is described into qualitative data, based on the assessment criteria (Widoyoko, 2015:238), it is considered as "Good" criteria.

The percentage of feasibility of draft IV student worksheets in the large-group test can be obtained by using the formulation by Arikunto (Purbasari, 2012:3) as follow.

$$(\%) = \frac{\sum jumlah\ rata-rata\ skor}{\sum rerata\ skor\ ideal} \times 100$$
$$= \frac{63,32}{80} \times 100\% = 79,15\%$$

*rata-rata skor: score average
Rerata skor ideal: ideal score average

From the calculation above, the percentage of feasibility obtained is 78,15%, if the data is described in the

predetermined scoring scale according to Arikunto (Purbasari, 2012:3), it shows that the quality of draft IV student worksheets is categorized "Very Feasible" from the whole aspects.

Thus, the draft IV student worksheets have a good response from the students' experiences in using the worksheets for the learning process in the large-group test and the worksheets can be said very feasible to use by the students outside of the subject of this research.

Based on the analysis of the data obtained from the student worksheets assessment by the experts (material, design, and media) and the data of students' responses obtained from product testing, it can be concluded that the developed student worksheets meet the validity and practicality criteria.

4. DISCUSSION

The Development of Student Worksheets on Similarity and Congruence with the *group investigation* method is based on ADDIE model, abbreviation of analysis, design, development, implementation, and evaluation. The product resulted from this research is the group investigation based student worksheets on Similarity and Congruence for the 9th Grade Students.

In the analysis stage, the researcher conducted the analysis of competence or curriculum analysis, analysis of students' characteristics and material analysis. From this stage, it was concluded that it is necessary to develop student worksheets based on any particular method to make the students active and independent in finding a concept. Given this necessary, it is selected for the group investigation learning. Group investigation can encourage the students to be active and sensitive to the social dimension of the learning process. Students should be involved in learning activities to find a mathematical concept with their own group.

The second stage in the procedures of this research is the design stage. The activities conducted at the design stage of student worksheets include reference collection, arrangement of the group investigation based student worksheets design (arranging the map of student worksheets needs, determining the title of each worksheet and writing the design of student worksheets) and arranging the instruments for student worksheets assessment.

At the development stage (development), the researcher developed student worksheets based on the draft that had been developed at the design stage, by which then the draft I student worksheet produced. The draft I student worksheets were consulted with the supervisor and were then validated. The validation showed that the draft I student worksheets may be feasible to use in student test with some revision. The following are the revisions of the draft I student worksheets based on the revision suggestions from the experts (material, media and design)

1) The *cover* of student worksheets is less able to display the subject of Similarity and Congruence as well as the *Group Investigation* basis.

2) In the foreword, there is a text should have a capitalized letter in the beginning. Shall all foreign languages in the group investigation based student worksheets are *italic*.

3) There is one of the titles in references "*halaman kompetensi*" which should be replaced by "*Standar Kompetensi*".

4) The title of competence should be replaced by "*Kesebangunan dan Kekongruenan/*Similarity and Congruence" only.

5) The points in the manual instructions of student worksheets should be numbered. The use of figures/pictures should be available on all stages of group investigation or it would be better to not use the figures/pictures at all. The researcher decided to not use any figure/picture in the *group investigation* stages.

6) KD (Standard of Competence) on the title of student worksheets is not necessarily presented since it has been presented on the competence page/*halaman kompetensi*.

7) The instructions of student worksheets on *grouping* should be shortened.

8) The questions are suggested to be put before the display of two-dimensional/plane figures (*bangun datar*). The two-dimensional/plane figures should not be presented excessively since it is possible to confuse the students.

9) The use of alphabet on angles such as rectangle, SPHERE, WEDGE/*KEJU* and NCIL as in the topic of problem 2 is suggested to be replaced by *segi empat* (rectangle) ABCD, followed by other alphabet of EFGH, and so on, suited to the alphabetical order.

10) The process of problem solving or topic of problem is suggested to be directed suited to the limitation of the students in answering the questions.

11) There should be a box to answer the questions on *evaluating*.

12) The ornaments in every stage of *Group Investigation* seem to make the pages full, which are concerned to make the students getting bored when they study using the *Group Investigation* based student worksheets, thus, it is suggested to eliminate the ornaments.

13) Pay more attention to the *margin* in order to avoid the frame of the worksheets cut in the printing.

14) The word "*segiempat*" (rectangle) should be replaced by "*segi empat*"

The following stage is implementation stage. The researcher conduct a product testing on the developed student worksheets. The researcher distributed questionnaires concerning students' responses in the product testing. The test includes: individual test to three students in order to find out their responses on the draft II student worksheets, small-group test to six students in order to find out their responses on the draft III student worksheets, and large-group test to the real classroom test in order to find out the students' responses on the draft IV student worksheets through their experiences in using the worksheets.

The final stage of the research procedures is the evaluation stage. Evaluation was conducted to collect the data from each stage of research procedures in order to perfect/improve the developed product. The data obtained in this stage include:

1) The result of validation conducted by the material experts obtained the average score $X = 4,13$. It shows that the draft I student worksheets has good criteria based on the aspects of material. The percentage of feasibility is 82% which is categorized very feasible. Thus, the draft I student worksheets is said feasible based on the aspects of material.

2) The result of validation conducted by the design expert obtained the average score $X = 3,87$, It shows that the draft I student worksheets has good criteria based on the aspects of design. The percentage of feasibility is 77,9% which is categorized very feasible. Thus, the draft I student worksheets is said feasible based on the aspects of design.

3) The result of validation conducted by the media expert obtained the average score $X = 4,73$, . It shows that the draft I student worksheets has good criteria based on the aspects of media. The percentage of feasibility is 94,29% which is categorized very feasible. Thus, the draft I student worksheets is said feasible based on the aspects of media.

4) The individual test is a product testing on the draft II student worksheets. It obtained the average students' response of $X = 4,75$. It states that the draft II student worksheets obtained a very good response from the students. In addition, the percentage of feasibility of 95,03%, shows that the draft II student worksheets are categorized very feasible.

5) The small-group test is a product testing on the draft III student worksheets. It obtained the average students' response of $X = 4,28$. It states that the draft III student worksheets obtained a very good response from the students. In addition, the percentage of feasibility of 85,8%, shows that the draft III student worksheets are categorized very feasible.

6) The large-group test is a product testing on the draft IV student worksheets. It obtained the average students' response of $X = 3,92$. It states that the draft IV student worksheets obtained a very good response from the students. In addition, the percentage of feasibility of 79,2%, shows that the draft IV student worksheets are categorized very feasible.

Based on the analysis of the data obtained from the student worksheets assessment by the experts (material, design, and media) and the data of students' responses obtained from product testing, it can be concluded that the developed student worksheets meet the validity and practicality criteria.

5. CONCLUSIONS

Based on the results and discussion above, there are some conclusions of the research, as follows.

1. The development of group investigation based Student Worksheets on Similarity and Congruence for the 9th Grade Students was conducted based on the ADDIE model which consists of: analysis, design, development, implementation, and evaluation.
   a. Analysis stage includes: Curriculum analysis, Material analysis, and student analysis. Since the students in every school have different characteristics or skills/ability, the most concerned in this stage is the student analysis.
   b. Design stage includes: reference collection, arrangement of the group investigation based student worksheets design (arranging the map of student worksheets needs, determining the title of each worksheet and writing the design of student worksheets) and arranging the instruments for student worksheets assessment.
   c. The development stage is developing the draft I group investigation based student worksheets. The draft I student worksheets were previously assessed by the experts (material, media, and design experts) using the assessment instruments which have been consulted firstly with the supervisor and approved by the experts.
   d. The implementation stage includes: individual test on draft II using "students' responses questionnaire for individual test", small-group test on draft III using "students' responses questionnaire for small-group test", and large-group test on draft IV using "students' responses questionnaire for large-group test".
   e. The evaluation stage aims at collecting data obtained from the development stage from the experts and data obtained from implementation stage from the product testing.

2. A part of the purposes of this research is to find out the quality of student worksheets (validity and practicality) on the developed student worksheets.
   a. Based on the result of validation carried out by the material experts, the average score obtained is 4,13 which has good criteria and the percentage of feasibility of 82% is categorized very feasible.
   b. Based on the result of validation carried out by the design expert, the average score obtained is 3,87 which has good criteria and the percentage of feasibility of 77,9% is categorized very feasible.
   c. Based on the result of validation carried out by the media expert, the average score obtained is 4,73 which has good criteria and the percentage of feasibility of 94,29% is categorized very feasible.
   d. Based on the students' responses on the individual test, the average score obtained is 4,75 which has very good criteria and the percentage of feasibility of 95,03% is categorized very feasible.
   e. Based on the students' responses on the small-group test, the average score obtained is 4,28 which has very good criteria and the percentage of feasibility of 79,2% is categorized very feasible.
   f. Based on the students' responses on the large-group test, the average score obtained is 3,92 which has very good criteria and the percentage of feasibility of 79,2% is categorized very feasible.

Based on the analysis of the data obtained from the student worksheets assessment by the experts (material, design, and media) and the data of students' responses obtained from product testing, it can be concluded that the developed student worksheets meet the validity and practicality criteria.

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