Development of students’ worksheets based on a scientific approach for set concept in grade VII Junior High Schools 10 Bengkulu City

S Wulandari¹* and F S Syafri²

¹ Program Studi Tadris Matematika, Institut Agama Islam Negeri Bengkulu, Jl. Raden Fatah Pagar Dewa, Telp. (0736) 51276 Kota Bengkulu 38211, Indonesia
² Departemen Tadris Matematika, Institut Agama Islam Negeri Bengkulu, Jl. Raden Fatah Pagar Dewa, Telp. (0736) 51276 Kota Bengkulu 38211, Indonesia

*Sepiwulandari122@gmail.com

Abstract. This research is to develop a mathematics learning tool for Student Worksheet (students worksheets) based on a scientific approach that is valid, effective, and practical. The research method used is the development research with the Plom Model consisting of 3 stages, namely the initial investigation phase (preliminary research), the development phase or making a prototype (development or prototyping phase), and the assessment phase (assessment phase). The subjects of this study were students of class VII SMP 10 Bengkulu city consisting of 32 students. Data collection techniques in the preliminary stage are document analysis, while the formative evaluation stage is walk through, observation, and students worksheets tests. The results of this study are in the form of products, namely: Student Worksheet (students worksheets). The results showed that the students worksheets in the valid category based on the score obtained 3.50 was stated to meet the criteria, for practicality tests a score of 3.55 met the criteria stated practical, whereas for the effectiveness test a score of 83 had met the completeness criteria, so it can be said that the learning kit students worksheets mathematics based on a scientific approach to class VII material can already be used.

1. Introduction
Mathematics is a universal science that encompasses all knowledge from science, social to religious sciences and is related and Requires mathematical calculations. Therefore mathematics must be learned by students at every level of education, starting from elementary school to University. The purpose of learning mathematics according to the 2013 curriculum [1] is to emphasize the modern pedagogical dimension. In learning mathematics must be in accordance with the rules, namely using a scientific approach. In mathematics learning activities undertaken so that learning is meaningful that is observing, asking, trying, reasoning, presenting, and creating.

The results of the PISA (Program for International Student Assessment) study, which is a study that focuses on literacy, mathematics, and Natural Sciences (IPA), shows that Indonesia's ranking can only occupy the bottom 10 of 65 countries (Kemendikbud in Yuliani, 2014: 241). The results of this study indicate there needs to be a change in learning activities because the purpose of providing mathematics learning to all students starting from elementary school is to equip students with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to cooperate...
Learning mathematics in junior high includes arithmetic, algebra, geometry and statistics (BNSP, 2006: 140). One of the algebraic materials in mathematics in seventh grade junior high school is set material.

Observations made by researchers with mathematics teachers in SMP N 10 Bengkulu City Class VII during the second internship aimed at achieving learning outcomes achieved by students on the set material is still low. In observations made during the two lessons, it was found that in mathematics learning the teacher already had a complete learning support component, including learning materials for the Student Worksheet.

The results of observations on students worksheets used at school found that students worksheets that were commonly used by teachers had not been refined based on the rules and criteria in the 2013 curriculum. This condition could be seen in the students worksheets used that still contained only material and practice questions. This students worksheets does not yet support giving students an understanding of the concept in accordance with the 2013 curriculum reference.

The use of students worksheets in learning is expected to have a positive influence and a sizeable contribution to the learning achievement of students. Especially on learning set material. Based on the description above, the writer is interested in conducting research by raising the title "Development of Student Worksheets Based on Scientific Approaches on Class VII Material Assemblies in SMP Negeri 10 Bengkulu City." The purpose of this study is to produce students worksheets products and find out whether students worksheets are produced meet valid, practical, and effective criteria.

2. Methods
The method in this study is development Method / design research. The product developed in this study is students worksheets on the set material. The development model used is the Plom model. The Plom model consists of 3 phases, namely the preliminary research phase, the development or prototyping phase, and the assessment phase [2].

The first phase or initial face investigation (need and context analysis). This phase is carried out with several activities including: Requirement analysis (analysis of the problems contained in the existing learning tools), Concept analysis (analysis of the main materials to be studied by students), Student analysis, is to find out the characteristics of students and students worksheets that are preferred by students (interview).

The second phase or the phase of making Prototype (development or prototyping phase) is carried out students worksheets design activities, students worksheets development and formative evaluation (design development and formative evaluation).

The assessment phase, assessment phase is a semi-sumative phase which aims to determine the actual effectiveness of the interventions that have been produced at the development and prototype stages.

3. Results and discussion
The first phase or initial face investigation (need and context analysis). This phase is carried out with several activities including: needs analysis (analysis of the problems contained in the existing learning tools, teacher analysis and the way the teacher teaches material to students), concept analysis (analysis of the main materials to be learned by students seen from the textbook package used based on the 2013 curriculum), student analysis, is to find out the characteristics of students and students worksheets that are preferred by students (interviews). Based on the results of interviews conducted with students in SMP Negeri 10 Bengkulu city students like students worksheets which includes daily activities and activities that they normally do and the objects used must be close to the surrounding environment.

The second phase or the phase of making Prototype (development or prototyping phase) is carried out students worksheets design activities based on a scientific approach with steps from observing the problems that exist in students worksheets, Asking the activities of students to ask questions related to things observed, collecting data (gathering information from various sources to answer questions), associate (to see relationships based on information collected), conclusions (raise conclusions from the results of activities carried out), and communicate (activities convey things in front of the class).
development of students worksheets as a quality learning tool must be validity, practicality, and effectiveness. Validity test is done to find out whether the learning tools developed by researchers are in accordance with the characteristics of the scientific approach stages. Validity test is also conducted on research instruments to find out whether the research instruments that have been designed can be used in research. Practicality tests are carried out to find out whether it is easy, interesting and fun to use. Meanwhile, the effectiveness test was conducted to determine the extent of the usefulness of the learning tools produced. The validity test uses the students worksheets research questionnaire which filled out by 1 mathematics lecturer with S2 academic qualifications for the material test, 1 mathematics lecturer with S2 academic qualifications for the media test, and 1 lecturer with S2 academic language qualifications for the language test. The practicality test uses a teacher's response questionnaire, and the effectiveness of the results of the questionnaire given to students. Data analysis techniques validity test results, practicality tests, and effectiveness tests, which are carried out in four steps, namely (1) recapitulation of learning appraisal data and research instruments into a table that includes aspects, indicators, and values of validity, practicality, and values effectiveness for each validator, (2) determine the average value of the assessment results of all validators for each indicator, (3) determine the average value for each aspect, and (4) determine the validation score, which is the average f a total of average scores for all aspects. formative evaluation (design development and formative evaluation). Furthermore, the results obtained will be compared with the validity criteria of learning tools as in Table 1. Criteria for Categorizing the Validity of students worksheets.

Table 1. Validation assessment criteria.

| Interval | Validity Criteria | Note |
|----------|------------------|------|
| 1≤VA<2  | invalid          | full revision |
| 2≤VA<3  | less valid       | partial revision |
| 3≤VA<4  | valid            | no revision |
| VA=4    | very valid       | no revision |

Note: VA is the value of determining the validity level of learning device.

The data analysis technique of practicality test results was carried out with four steps, namely (1) conducting a recapitulation of practical assessment data which included: the value given by teacher respondents, (2) calculating the average value of results from all assessments given by teacher respondents for each indicator, (3) calculates the average practicality value (P), which is the average total value of the average value for all aspects, and (4) calculates the total overall practicality value (Ptot) of all assessments given by practitioners through the teacher's questionnaire responses. Furthermore, the results obtained will be compared with the practicality criteria of the learning device as shown in Table 2.

Table 2. Criteria for evaluation of practical results.

| Interval | Practical Criteria | Note |
|----------|-------------------|------|
| 1≤Ptot<2 | not practical     | full revision |
| 2≤Ptot<3 | less practical    | partial revision |
| 3≤Ptot<4 | Practical        | no revision |
| Ptot=4   | very practical    | no revision |

Note: P is the value of determining the practicality of a learning device.

The results of the development of this learning tool are students worksheets based on a scientific approach to the set of concept materials that have been tested for validity, practicality, and effectiveness. students worksheets consists of students worksheets title page, students worksheets Component (contains stages of learning activities based on a scientific approach), students worksheets content specifications (contains material titles, basic competencies and achievement indicators, students
worksheets work instructions, religious character circles, circle of motivational characters, time boxes and info box), Observing and Asking (containing illustrations of daily events related to the material to be studied which involves students to write down things they want to know in the form of questions), Collecting Data and Associating (gathering information needed by reference), and making activities related to objects discussed in daily life, and conclusions (the results of discussion activities carried out in students worksheets).

This research was conducted on grade VII students of SMP Negeri 10 Bengkulu city in the odd semester of 2018/2019. And get the results of calculations from the data processing of each questionnaire on the formula of the questionnaire measurement scale and the data must be valid, practical, and effective. Namely as follows:

Table 3. Data analysis of the results of the initial prototype validity test by the validator.

| No. | Prototype type       | Validation I | Validation II | Validation III | Average  | Validation Criteria | Note     |
|-----|----------------------|--------------|--------------|----------------|----------|---------------------|----------|
| 1   | (Students Worksheets) | 3,31         | 3,57         | 3,63           | 3,50     | Valid               | No revision |

The results of the above analysis show that overall the initial prototype, the students worksheets learning tools and research instruments, have met valid criteria and do not need revision and can be used. However, researchers continue to revise based on suggestions and input validator to improve the completeness of students worksheets, namely writing the scope of the material systematically and attaching it in detail, clarifying the purpose of the illustrations in the students worksheets exploring section, 2) changing the word size to length, 3) the consistency of using the word measurement unit changed to meter, 4) added images related to illustrations given to students worksheets.

Table 4. Data analysis practical test results for students' worksheets by practitioners' teacher responses.

| No. | Research Instruments | Practicality Testers | Average | Practical Criteria | Note     |
|-----|----------------------|----------------------|---------|--------------------|----------|
| 1   | Teacher Response     | 1 teacher            | 3,55    | Practical          | No revision |

Based on Table 4, the results of the analysis above show that overall the initial prototype, which is the students worksheets learning device and research instruments, has fulfilled the practical criteria, obtaining a mean score of 3.55. Thus the students worksheets learning tools that have been developed are declared practical.

The estimation of assessment phase is a semi-summative phase that aims to determine the actual effectiveness of the interventions that have been produced at the development and prototype stages. In the assessment phase to meet the effective criteria in this case the T test was taken was 15 students with test scores in the class that received the treatment and the value of the test results in the class that did not get treated. And the results obtained based on the T test, the value of the results of the class that received treatment is higher than the class that did not get treatment.

The assessment phase of the assessment phase is a semi-summative phase which aims to determine the actual effectiveness of the interventions that have been produced at the development and prototype stages. In the assessment phase to meet the effective criteria in this case the initial students worksheets workmanship test is conducted and the second is the final students worksheets workmanship test in the same class with 32 students.

While the data analysis technique for effectiveness testing is done by (1) calculating the percentage of scores obtained for each aspect of students worksheets work from the initial test, (2) calculating the percentage of scores obtained for each aspect of students worksheets work from the final test, (3) comparing the acquisition of the percentage score obtained for each aspect between the initial test and
the final test. If there is an increase from the initial test results to the final test results, where the percentage value of each aspect of students’ worksheets work on the final test is higher than the percentage value of every aspect of students’ worksheets work on the initial test, the learning kit, students’ worksheets, is declared effective. The achievement criteria used are listed in the following table.

### Table 5. Criteria for achieving completeness indicators.

| % Achievement of completeness indicators | Category     |
|-----------------------------------------|-------------|
| 85 ≤ PIK ≤ 100                          | Very high   |
| 75 ≤ PIK < 85                           | High        |
| 60 ≤ PIK < 75                           | Medium      |
| 50 ≤ PIK < 60                           | Low         |
| PIK < 50                                | Very low    |

### Table 6. Data analysis of test results on the effectiveness of student worksheets learning tools from the student’s final grade.

| No | Research Instruments | Effectiveness Tester | Average | Effectiveness Criteria | Note     |
|----|----------------------|----------------------|---------|------------------------|----------|
| 3  | Questionnaire Student responses | 32 students | 83      | Practical              | Complete |

Based on the analysis of preliminary tests and final tests given to students of large group trial subjects, it can be stated that the mathematics learning kit, students’ worksheets, on a set of material based on a scientific approach, can be declared effective because based on average results, the score increases classically, increasing from 61.31 to 83 with a high category and meet the completeness criteria.

In addition to developing scientific-based students’ worksheets on the set concept material, there are also other ways or other developments undertaken by researchers in the development of teaching materials, namely the development of learning tools. Research conducted by Nursakiah [3], a Muhammadiyah University Makassar student with the title “Development of Mathematical Learning Equipment for Cooperative Group Type Investigation Settings with a Scientific Approach”, the results of the study showed the validity or validity after being tested according to the 2013 curriculum criteria for mathematics learning tools. Likewise, research conducted by Eka Romiati and Roseli Thesis [4] Mathematics alumni of the University of Jambi with the title "Development of students’ worksheets Based on Scientific Approaches and PQ4R Learning Strategies in Class VII Material Assemblies in SMP Negeri 11 Jambi City" the results of this research show that students’ worksheets developed have obtained good results in achieving the minimum completeness criteria in students because of the validation test results get a very good category. As well as research conducted by Natalia RR, Akbar S, and Sudiman [5] alumni of Postgraduate Mathematics Education at State University of Malang under the title "Development of Learning Devices based on Learning cycle-7e models on Trigonometry material to improve students' mathematical connection abilities" the results of this study indicate the developed student worksheet got very good results and reached the validation test criteria.

### 4. Conclusion

The mathematics learning tool developed in this study includes the Student Worksheet in mathematics learning as a whole that has met the valid criteria based on the results and discussion stated that the average score obtained was 3.50. This shows that the learning tools developed namely the Student Worksheet have met the stages in the scientific approach. For practicality tests conducted by mathematics teachers, the average score of practicality in students’ worksheets was 3.55. To test the effectiveness of the analysis of the initial test and the final test given to students of large group trial subjects, it can be stated that the mathematics learning tool, students’ worksheets, on the set of material-based scientific approach, can be declared effective because based on the mean results, the score increases classically, increasing from 61.31 a value of 83 with a high category and meets the
completeness criteria. thus, students worksheets learning tools based on a scientific approach to the set concept material for grade VII junior high school students are declared valid, practical and effective.

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