The validity of mathematic learning device based on learning cycle to improve reasoning abilities of junior high school’s students

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Abstract. The research problem in is the students' mathematical reasoning ability is low, it is caused by learning device designed by the teacher does not yet support how to construct student’s mathematical reasoning ability. Through the development of this learning instrument, it is expected that students' abilities in mathematical reasoning can increase. Learning tools are developed in the form of Lesson Plan and Student’s Worksheets. We use research Plomp’s model: initial research, prototype phase, and assessment phase. The results of preliminary analysis research, mathematical reasoning ability and student learning outcomes are still low. Teachers and students need learning tools based on Learning Cycle 5E with simple language and guide students to understand mathematics well. This study produced a valid mathematics learning device.

1. Introduction
Mathematics is main subject for all grade. It prosecutes students to understand mathematical concepts properly and correctly. In learning mathematics, students are trained to think using reason and logic to solve problems so that they understand concepts in the sense of “not memorizing” formulas [1].

The goals of learning mathematics, in [2] are (1) using thinking and reasoning skills in problem solving, (2) communicating ideas effectively, (3) having attitudes and behaviors that are in accordance with values mathematical values and learning, such as obedience, consistency, upholding agreement, respecting differences of opinion, thorough, tough, creative, and open.

The results of The Trends in International Mathematics and Science Study (TIMSS) in 2011 that Indonesia was ranked 41 out of 45 participants. According [3] stated that one of the factors of the low TIMSS results achieved by Indonesia was due to the lack of trained students in solving problems that demanded reasoning.

Some international studies also say similar things about the low of mathematical reasoning ability of students, namely Carrolin S. Ayal [4], and Suhendri [5]. Lacking mathematical reasoning ability was also found at MTs Mardhatillah Bukit Kandung and MTsN 4 Tanah Datar as shown in table 1.

Many factors can influence the low mathematical reasoning abilities of students in understanding mathematics, one of which is the maximum use of learning resources, both by educators and students. Learning resources are supporters of the success of students in understanding learning material. The source of learning is everything that is around the environment of learning activities that can be used by students to help optimize learning outcomes [6].
Table 1. Students' Mark on Mathematical Reasoning Ability in Function Topic.

| No | Indicator                                                                 | Average |
|----|---------------------------------------------------------------------------|---------|
| 1. | Presenting mathematical statements verbally, written, drawing and diagram  | 3.40    |
| 2. | Provide explanations using models, facts and relationships in solving problems | 3.21    |
| 3. | Give logical arguments                                                   | 2.67    |
| 4. | Find the pattern or mathematical symptoms to make generalizations or conclusions | 2.01    |
|    | **Total Score**                                                           | 11.29   |
|    | **Average Value of Mathematical Reasoning Ability**                      | 70.56   |

Learning resources have a role in the learning process that is effective and efficient. An effective learning process is a learning process that uses a variety of learning resources [6]. This was confirmed [7] that learning resources are all things or powers that can be utilized by educators, both separately and in a combined form, for the benefit of teaching and learning with the aim of increasing the effectiveness and efficiency of learning goals.

Based on observations, learning resources that are less supportive result in low learning activities of students. This is indicated by the fact that there are still many students who are not actively participating in the learning process, there are even students who do not care about the learning process. As for interviews with teachers at the school, teachers have used learning resources in the form of mathematical learning tools consisting of lesson plans, textbooks and student worksheet that have not been optimal. It is seen that the learning device has not encouraged students to find concepts and use their mindset.

Based on the analysis of the lesson plans used, teachers generally write it and explain the topic along with examples based on existing textbooks. The lesson plans and textbooks used are teacher-centered and have not fulfilled the needs of students to engage students actively in learning, both individually and in groups. Analysis of the textbooks used in the school, it say that the presentation of material is giving directly the final formula and student must be memorized.

In improving students' mathematical reasoning abilities, teachers and students should have learning tools in the form of lesson plans and student worksheet that can assist in the learning process. Therefore, it is necessary to develop learning tools in the form of lesson plans and student worksheet that can arouse students' interest, investigate, work together, apply concepts and be able to find new knowledge with familiar concepts. Learning tools in the form of lesson plans and student worksheet that are designed should be equipped with learning models that can facilitate students to understand the lesson. of the learning models related to this problem is Learning Cycle 5E.

Learning Cycle 5E is a learning model about how to finds and acquires new knowledge. Learning Cycle 5E consists of five stages, they are: engagement, exploration, explanation, elaboration and evaluation [8]. For this reason, the research on developing of its instrument was conducted and the purpose of this study was learning devised based on Learning Cycle 5E to produce a valid.

2. Methods
This research is a developmental research. Development research is a study which is used to produce certain products and test the effectiveness of these products [9]. The Development Model used is Plomp’s Model [10]. Plomp divides the development stage into three phases, they are preliminary analysis, design and develop phase (development or prototyping phase), and assessment phase
Advantages using it model is its practicality in three stages, they are one to one evolution, small group evaluation and field test [11].

In the prototype development and assessment phase we and revise instrument base on formative evaluation. Formative evaluation is an assessment of the strengths and weaknesses of the product in the development stage, with the aim of reviewing the product to improve validity. Formative evaluation will be illustrated in the figure.1

![Formative evaluation of the Plomp development model](image)

**Figure 1.** Formative evaluation of the Plomp development model [10].

We collect data using validation sheets, it is checked by expert lectures. The score of in validation sheet are then determined in the validity of learning kit by using the formula[17]:

$$R = \frac{\sum_{j=1}^{m} \bar{x}_j}{m}$$

Note:
- $R$ = Validity
- $\bar{x}_j$ = Mean score in the-j item
- $m$ = Number of item

Criteria for validity of learning tools based on Learning Cycle 5E can be seen in table 2.

| Average       | Criteria          |
|---------------|-------------------|
| $R > 3.20$    | Very Valid        |
| $2.40 < R \leq 3.20$ | Valid           |
| $1.60 < R \leq 2.40$ | Quite Valid      |
| $0.80 < R \leq 1.60$ | Less Valid       |
| $R \leq 0.80$ | Invalid           |

*source: Muliyardi [18]*
3. Result and discussion

3.1. Preliminary research results
Defice this stage are:(1) Need analysis, (2)Curriculum Analysis, (3)Analysis of Student, and (4) Analyze material/ concepts.

3.2. Result of development or prototyping (phase)
This phase development based on the result in the previous phase. In prototyping stage, we do a formative evaluation for each phase. In this phase we design design the process of this device is: designing lesson plans, student worksheet and Assessment Instrument.

3.3. Assessment phase
This phase design results prototype I, then do the self-evaluation and validated expert or expert assessment carried out. Learning Cycle 5E learning implementation plans was validated by five experts, they are three lecturer in mathematics, one Indonesian language lecturer and one lecturer in education technology. Lesson plan validation results based on guided findings are presented in table 3.

| No | Rated aspect                      | Average | Categories |
|----|-----------------------------------|---------|------------|
| 1  | Lesson Plans Components           | 3.52    | Very Valid |
| 2  | Learning Activities               | 3.5     | Very Valid |
| 3  | Leanguage and legibility          | 3.75    | Very Valid |
|    | Total Mean                        | 3.59    | Very Valid |

Table 3. Results of Lesson Plan Validation Assessment.

Based on the Table 3, it can be concluded that overall Guided discovery based on lesson plan very valid criteria an average index of validity 3.59. Student worksheet validation results based on guided findings in all aspects can be seen in table 4.

| No | Aspects Rated                  | Average | Categories |
|----|-------------------------------|---------|------------|
| 1  | Presentation/Didactic         | 3.75    | Very Valid |
| 2  | Content Feasibility           | 3.66    | Very Valid |
| 3  | Language                      | 3.75    | Very Valid |
| 4  | Integrity / Display           | 3.35    | Very Valid |
|    | Total Mean                    | 3.81    | Very Valid |

Table 4. Recapitulation Result of Student Worksheet based Learning Cycle 5E.

4. Conclusion
The conclusions in this reaseach is the mathematics learning devises based on Learning Cycle 5E in the form of lesson plan and student worksheet are valid.

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