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The Development of HOTS Problems on Geometry and Measurement for Junior High School

Iftitah Primasanti
Magister Mathematic Education
FKIP Universitas Sriwijaya
Palembang, Sumatera Selatan, Indonesia.
iftitahprimasanti8@gmail.com

Darmawijoyo
Magister Mathematic Education
FKIP Universitas Sriwijaya
Palembang, Sumatera Selatan, Indonesia.

Somakim
Magister Mathematic Education
FKIP Universitas Sriwijaya
Palembang, Sumatera Selatan, Indonesia.

Ning Eliyati
Magister Mathematic Education
FKIP Universitas Sriwijaya
Palembang, Sumatera Selatan, Indonesia.

***Abstract*— This study aims to produce HOTS material geometry and valid, practical, and potential effects. The research method used in this study is the method of design research type development study. This research was conducted on eighth-grade students at SMP Negeri 1 Palembang. Data collection techniques include walkthrough, documentation, interviews, and tests. The question is said to be validly seen from the results of the validator's assessment and comments/suggestions of students at the one-to-one stage. The practicality of the questions is shown in the small group results. The potential effect is seen from the results of students' answers during the field test. The questions developed have had a potential effect seen from the results of the field test, eliciting the ability to analyze (C-4), evaluate (C-5), and create (C-6). This research has produced as many as 16 HOTS questions about geometry and measurement materials that are valid and practical and have potential effects and are suitable for use.**

Keywords: component, HOTS, geometry and measurement, junior high school

I. INTRODUCTION

In facing the challenges of global competition and for the process of solving problems in everyday life, a person must be able to use Higher-Order Thinking Skills (HOTS). Where is the ability to think that not only remembers (recalls), restates (restates), or refers without processing (reading). HOTS questions in the context of the assessment measure the ability of 1) transferring one concept to another, 2) processing and applying information, 3) looking for links from different kinds of information, 4) using the information to solve problems, and 5) analyzing ideas and information critically [1].

High order thinking should be present in students in Indonesia as a provision for them in facing the global era, advances in information technology, the convergence of science and technology as the impact of technology, and the rise of creative industries in the future [2]. According to [3], students who have good high order thinking will commit to continue learning, grow, and develop and evolve to become more advanced. Also, these students will be better able to interpret and review existing information and be able to use the information to solve the problem at hand.

High order thinking, according to Bloom's Revised taxonomy [4], is an ability that includes levels of Analyze, Evaluate, and Create. Higher-Order Thinking Skills is defined as a thinking ability that includes critical, logical, reflective, metacognitive, and creative thinking [5]. High-level thinking ability is defined as the wider use of the mind to find new challenges. This ability to think at a higher level requires someone to apply new information or prior knowledge and manipulate information to reach possible answers and new situations [6]. According to[7] say HOTS in students can be empowered by giving unusual problems, so students can successfully explain, decide, demonstrate, and produce problem-solving in the context of knowledge and experience.

However, the fact in the field of high order thinking ability is still very low among high school students. The research conducted by [8], states that based on the results of data analysis from the field test shows that 24 students (68.6%) belong to very lacking in HOTS. One of the factors that cause the ability to think is still low is the lack of trained Indonesian children in completing tests or questions that are demanding analysis, evaluation, and creativity. Problems that have these characteristics are problems to measure HOTS [9].

Development of Higher-Order Thinking Abilities has been investigated by Jean Butkowski [10] in his thesis entitled Improving Student Higher Order Thinking Skills in Mathematics for elementary school grades three, five, and six. This study concludes that students' skills in problem-solving strategies become good; the level of student confidence in mathematics also becomes good. It was also concluded that a person's high-level mathematical thinking ability cannot be obtained instantly, but must be trained by the teacher in learning mathematics.

Therefore we need to practice questions that can be used by the teacher to train students to think at a high level. Based on

the description that has been explained above, the researcher is interested in conducting a study entitled "The Development of HOTS Problems on Geometry and Measurement for Junior High School."

II. RESEARCH METHODS

This research is a research design type of development studies. The stages of the study consisted of two stages, including the preliminary stage and the prototyping stage, using the formative evaluation flow [11-12]. This study aims to produce high-level thinking questions (HOTS) in junior high school geometry and measurement material. Also, to see the potential effect of high-level thinking questions on the learning outcomes of geometry and measurement materials in junior high school. This research was conducted at SMP Negeri 1 Palembang in the academic year 2018/2019. The subjects of the study were the eighth-grade students of SMP Negeri 1 Palembang. Following is a picture of the formative evaluation design flow.

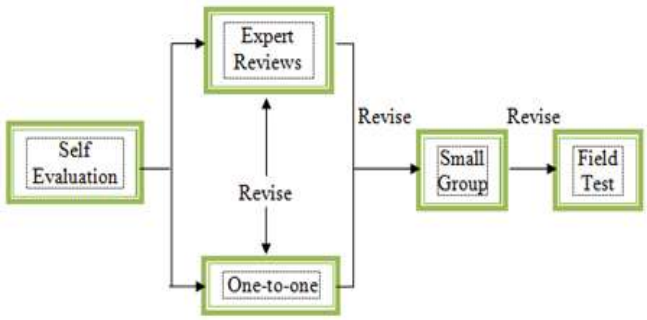

Fig. 1. Formative Evaluation Design Flow [11-12]

III. RESULTS AND DISCUSSION

The questions generated from the development of the questions in this study were about HOTS geometry material and measurements in junior high school as many as 16 items. The questions consist of 6 questions with C4 level, five questions with C5 level, and five questions with C6 level. There are two stages discussed in this chapter, namely the preliminary stage and the formative evaluation stage. The formative evaluation phase consists of self-evaluation, expert reviews and one-to-one, small groups, and field tests.

A. Preliminary Phase

This stage includes the analysis and design of the instrument.

- The analysis carried out aims to analyze the ability of eighth-grade students of SMP Negeri 1 Palembang. Before conducting research, research on the curriculum of Palembang 1 Public Middle School will be used to develop questions. The purpose of curriculum analysis is to find out Basic Competencies, as well as indicators of questions to be developed by researchers. The curriculum used in this development is the 2013 curriculum.
- In the design phase, the researcher designed the HOTS questions based on the steps of the preparation of HOTS questions from the Ministry of Education and Culture 2017. The results of the preliminary stage were the initial prototype, which consisted of a grid of questions and question cards. The questions generated on the initial prototype were 16 questions.

B. Formative Evaluation Stage

1) Self Evaluation

At this stage, researchers are evaluating the initial prototype based on the characteristics that are the focus prototype. The characteristics that are the focus of the prototype are in terms of content, construct, and language. In terms of content, researchers evaluate questions that have been designed, whether included as HOTS questions or not. It also evaluates the context and predicts whether the level is following the HOT indicator. Then evaluate the questions whether the questions are following the basic competencies in the curriculum. Then in terms of construction, the researcher evaluates whether the questions designed as a picture have been presented clearly, readable, and functioning. In terms of language, the researcher evaluates whether the language of the questions is following EBI (Indonesian Spelling), the questions do not contain multiple interpretations, the questions are not convoluted, the limits of questions, and answers to questions are clear. The results obtained at this stage are prototype 1.

2) Expert Reviews and One-to-One

At the expert review stage, the validation of the questions was examined in terms of content, construct, and language by the thesis supervisor, Dr. Somakim, M.Pd. Also, researchers sought the opinions of several experts who were experienced as expert validators. The validators are Dr. Destiniar, M.Pd (Lecturer at PGRI Palembang University), and Dr. Bambang Suprihatin, M.Sc (MIPA Lecturer at Sriwijaya University).

The validation process with Dr. Destiniar M.Pd, was conducted face to face at PGRI Palembang University. Validate with Dr. Bambang Suprihatin, M.Si was done by giving a device that was developed to him after sometime later, the new researchers accepted the results of the validation. The validation process with a mathematics teacher, Nurjannah, M.Pd, was carried out face to face in SMP Negeri 1 Palembang.

Based on comments/suggestions from expert reviews and one-to-one, the questions on prototype 1 are then revised and revised so that it becomes a valid prototype 2 and will be tested at the small group stage. The matter revision decision that was developed based on expert reviews and one to one advice/comments can be seen in Table 1 below:

TABLE I. PROBLEM REVISION DECISIONS DEVELOPED BASED ON EXPERT REVIEWS AND ONE TO ONE ADVICE/COMMENTS

Before revision	After revision
Pandu wants to give the basketball to his best friend as a birthday present. The gift will be wrapped in a box, design the size of the box, and the volume of the box that the guide uses to wrap the basketball with a diameter of 2.85 dm? What is the minimum area of gift paper used to wrap the gift?	Pandu wants to give his friend 3 dm diameter basketball to his friend as a birthday present. The gift will be wrapped in a box. Help Pandu design the size of the box and the volume of the box used to gift basketball! Calculate the minimum area of gift paper used to gift the gift?

Fig. 2. One to one activities

3) Small-Group

At the small group stage, the prototype 2 questions are used as a problem that is used in the learning process. The small group trial was held twice at the SMP Negeri 1 Palembang meeting. It begins with researchers who act as teachers. At the core activity, the researcher gives apperception to students. Then the HOT questions (C4, C5, and C6) total a total of 16 questions to six students. Students are asked to work on problems individually. As students work on HOT questions, the researcher goes around observing the students' work and asking how to get the answers. Based on the small group stage, it can be concluded that six students can understand the question well, and understand the instructions contained in the question. Some students can answer well and meet 3 HOTS indicators of the level of reasoning. But there are still students who are not careful in working on the problems so that the final result is wrong. HOTS geometry and measurement material problems are already said to be practical because they can be applied and can be done by students.

At this small group stage, HOTS questions on geometry and measurement did not change in terms of content, construct, and language. Resulting in 16 prototypes 3 questions that will be used at the field-test stage. Then it was tested on 28 students of class VIII of SMP Negeri 1 Palembang to find out the potential effects of the questions developed.

(a) (b)

Fig. 3. (a) Student activities at the first small group meeting (b) Student activities at the second short group meeting

4) Field Test

In the field test stage, prototype 3 was tested on the research subjects, namely 28 students of SMP Negeri 1 Palembang grade VIII 4. After students finish working on the test questions, the researcher then analyzes the results of the students' answers to find out any potential effects that arise from the questions developed by the researcher.

Fig. 4. (a) Student activities on the first meeting Field test (b) Student activities on the second meeting Field test

The following is an example of a discussion of C6 level questions and the results of student answers at the field test stage to see the potential effects seen from the process of students working on problems with their respective strategies.

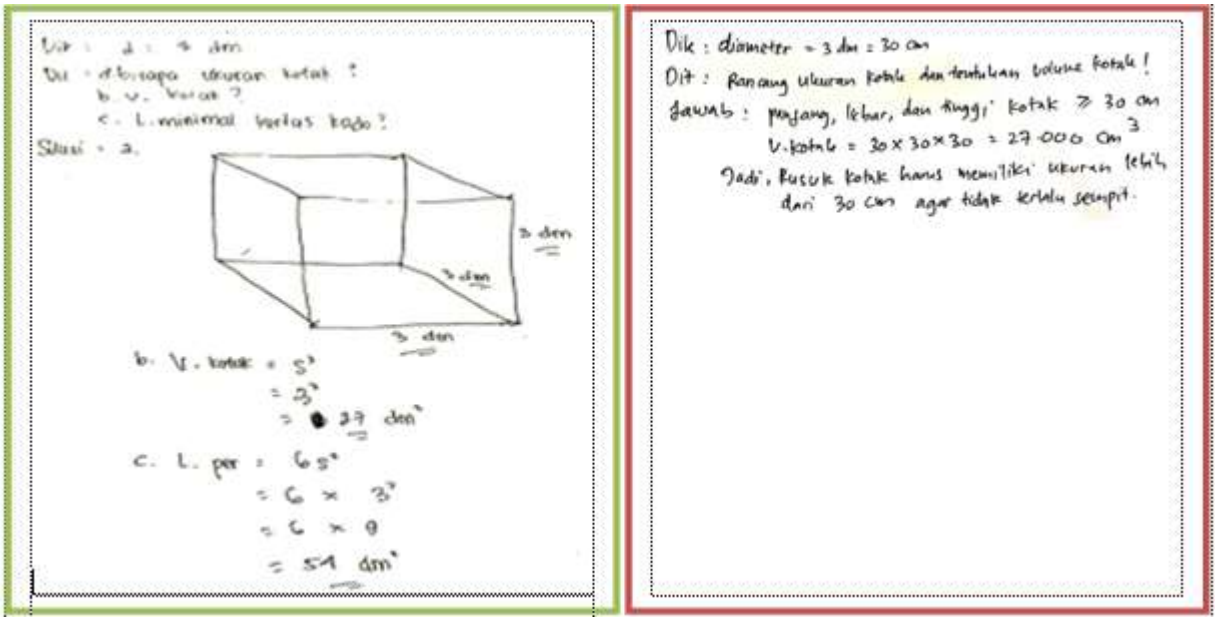

Fig. 5. Answers to number 8

The picture above is a student's answer to question no. 8, the green color shows that the students' answers are able to design a way to solve the problem by being able to determine the box used in the form of a cube, students are able to make a generalization of an idea or point of view by being able to design the size and volume of the box correctly and precisely, and students are able to organize elements or parts of new structures that have never existed by being able to determine the minimum area of gift paper used to wrap gifts. So from students' answers that students have met 3 indicators of HOT level C6 questions.

The red color image shows the students have not been able not yet to be able to organize the elements or parts of new structures that have never existed by not being able to determine the minimum area of gift paper used to wrap gifts. Seen in the results of students 'answers can only determine the size and volume of the box used to gift wrapping paper but do not look for the minimum area of gift paper used to wrap gifts so from students' answers if students do not meet 3 indicators of HOT level C6 questions.

From the results of the analysis of the field test students, the questions developed have had a potential effect seen from the results of the field test, eliciting the ability to analyze (C-4), evaluate (C-5), and create (C-6).

IV. Conclusions

This research has resulted in HOTS material geometry and measurement of 16 questions that are valid and practical and have potential effects and are suitable for use. The validity of

the questions is shown from the results of the validator's assessment at the expert reviews stage, where the researcher gets suggestions and comments in terms of the content, constructs, and language of the questions. Validity is also obtained from the comments or suggestions of students in the one-to-one stage of the readability of the questions. For practicality at the small group stage, students can already understand HOTS geometry and measurement material well so that the questions developed can be applied and can be done by students. The questions developed have had a potential effect seen from the results of the field test, eliciting the ability to analyze (C-4), evaluate (C-5), and create (C-6).

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