

# Cognitive Assessment Development on Quadrilateral Topic on 7<sup>th</sup> Grade Of Student

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**Abstract**—The purpose of this research is to develop a cognitive assessment in the topic of quadrilateral on 7<sup>th</sup> Grade Junior High School student based on the Revised Taxonomy Bloom. This is a development research which aims to produce an instrument to measure the validity and effectiveness of this assessment. This research was conducted in Riau province, Indonesia. Based on the results of research and revision, it can be concluded that this research has obtained a final product of cognitive assessment devices on quadrilateral topic of 7<sup>th</sup> grade of Junior High School students that has been measured of validity and effectiveness.

**Keywords**—cognitive assessment; revised taxonomy bloom; quadrilateral; validity; effectiveness

## I. INTRODUCTION

Good teaching and learning process should be preceded by good preparation [1]. As a base for the development of learning that should be examined the real of learning instrument. In this research, the issues discussed and developed oriented toward the development aspects of the assessment instrument. In an effort to improve the quality of education in schools, the government of Indonesia has been engaged to hold the repair and renewal of the education system. The effort had done by made changes of the curriculum, assistance in school textbooks, upgrading and training of teachers. One business that is important enough is the learning process improvement efforts.

Actually, some of the assessments have not measured the cognitive abilities to the highest levels of Bloom is Taxonomy, such as C4, C5, and C6 (based analysis of the books students and teachers). Based on the theory of constructivism Piaget and Ausubel meaningful learning theory, students need not only have knowledge but also develop the aptitude to analyzes, evaluation (critically) and make problem solve by themselves. The main cognitive is considerable to be measured based taxonomy Bloom, that is different from the assessment which some of teachers has constructed. The original taxonomy from Bloom 1956 developed six major of cognitive, such as Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. The taxonomy was changed from Anderson and Karthwohl that add “create” at C6 and removed synthesis at C5 and also at level of knowledge.

The previous research from Gabriela in 2013 has made the development of thinking skills of students with questions

based taxonomy bloom at elementary school in Art object, but the concept is the activity in the class to reach the purpose level of cognitive in taxonomy bloom. Then, from the others researches are not the development from the tool of revise taxonomy bloom, and not in the mathematic learning. Such as the research that Airsian and Miranda conducted in 2002, the assessment is divided for many forms, like quiz, groups and performance in the table of revised taxonomy Bloom. The research was not shown what to make the best questions to develop student is thinking that differ from standard instrument.

The functions of Bloom is taxonomy that have been raised, are not fully aware of teachers that Bloom is Taxonomy especially how teachers rate students' cognitive are located to improve for the next stage of thinking. The previous research to implement this function is performed by Peter and Helena, in the "Theory into Practice" Anderson and Karthwohl who concerning in the rules of assessment on revised taxonomy bloom, but is not development that but only in terms of the uses of tables Bloom is Taxonomy, and originated for the activities in the classroom.

This article is reviewing based on the research and development of cognitive and affective assessment in 2015 following the curriculum 2013 in Indonesia. Teacher can use table which contain the knowledge and cognitive process dimensions that called Taxonomy Table. Using the table to classify objectives, activities, and assessments provides a clear, concise, visual representation of a particular course or unit such as multi-level equations, graphics, and tables are not prescribed, although the various table text styles are provided [2]. Besides, actually based purpose of curriculum that mathematic is used to develop the attitude of logical, analytical, systematic, critical, and creative.

As follow, it is very important to make a product from cognitive assessment based revised taxonomy Bloom in junior high school, especially for mathematics which has been valid and effective. So that, teachers can redevelop assessment instrument to improve the cognitive level of students' knowledge and accordance with the objectives of the curriculum, NCTM and learning theory in the form of tests. So that the evaluation results can be used as a base material and improvement of the quality of the learning process towards improvement of the quality of learning, the teachers are required to pay attention to the quality of

learning tools that are used in order to achieve the purposes of evaluation.

#### A. Cognitive Assessment

Student achievements are changing as today depend on what student faces and to solves It in the world especially in education pervade new knowledge, skills and behaviors that have not yet been defined [3]. Students not only fast in changing context but also expand their knowledge, understanding of discipline but also to analyze, synthesis, and connected to critical thinking and problem solving. Those factors above need to be concerned by teachers, parents, researchers and education system. To do so they need assessment. Assessment is one of the central importance in education, and also carried out during the learning at the school and classroom level [1]. Then, assessment should be determined the quality of student understanding and thinking as well as specific content or processes.

The process of assessment is the reflection from learning process by the measured tool, and a purpose of the assessment. So, the teacher can know the aptitude of students and evaluation from the learning process by the outcome of measuring. From that process, assessment can be divided into formative and summative domains. Formative assessment has many various methods to measure for having feedback to develop the learning process, and also student can develop the level of thinking and knowledge. Besides, the summative assessment is based on the standard in curriculum and the result is a final judgement [4].

The cognitive can be measured theoretically of assessment, by the Piaget theory which constructed to development knowledge from the brain on level of thinking. There are many comparative views of the theory between Piaget and Ausubel, but then this assessment is adapted from that is theories. From the Piaget, the question based from the development of children of thinking level and construct by themselves from one step to another step. Then, we combining that with the Ausubel theory, which contain meaningful learning as the most effective type of education [5].

The good learning, can be measured by the assessment, so for getting the good measuring in assessment, this research is following the principles for assessment, such as:

- a. The method of assessment must be clear for step to step, valid, effective, reliable and consistent.
- b. Improve the student capability and indicated what indicator (purpose of learning) that student able to understand.
- c. Become an integral component of learning, not just for the input, but by measuring in process.
- d. The assessment is following for the evaluation of next learning process.

#### B. Taxonomy Bloom (revision)

The taxonomy Bloom has been revised from Bloom is students Anderson and Karthwohl in 2001 into six major of cognitive. They improved the original Blooms Taxonomy in two dimensional frameworks that help us to classify a broader

range of learning targets and assess. Six major of cognitive are follow 1) remembering (C1); is a process to use long term memory in order to retention. 2) Understanding (C2); is students' aptitude to construct the meaning of lesson whether it is in oral, writing or graphic. 3) Applying (C3); is involved to solve the problems or make exercise to be done. It closely likes procedure to finish the assignments. So, the problems are assignments which the answers have not yet been known by students [6]. 4) Analyzing (C4); is the process to separate a whole big problem into small pieces and make relationship among them. 5) Evaluating (C5); is a process to make a judgment and creating (C6). That is not quite different to the origin taxonomy, but that majors are in verb from are not like noun in the origin major before. And also at level knowledge in revised taxonomy as factual (basic), conceptual (identify the relationship), procedural (how to do something), and metacognitive (the strategy for solve problem). [2]. There are many words to measure cognitive aptitude from writing test for student, and then we use the words to make the cognitive assessment for student, that is all from six major of cognitive and level of knowledge.

Beside level of knowledge namely factual, conceptual and procedural, student need strategy to use it all to solve the problems. This strategy is called metacognitive. Metacognitive is further category in revised taxonomy Bloom.

Metacognitive is further category in revised taxonomy Bloom which has been developed by scientists [7]. Some of students need to use the strategy to solving problems or questions. So, besides factual, conceptual and procedural in the contents of learning, different from metacognitive that is the strategy from the knowledge in the mindset from the content that is same.

This research uses the table of revised taxonomy for construct the question after the modification of development. Then, we will discuss why we use revised taxonomy for the assessment? There are some functions for that answers [8].:

- a) We can analyze the suitable between question with the standard competency and curriculum purpose.
- b) By the taxonomy, we can have the tool for planning, implementing by measuring the student.
- c) We can know level of cognitive and knowledge of students, and then achieved the next level to develop the cognitive process of students.
- d) Taxonomy more than useful for the assessment, we can design learning model by that levels for activity in step by step problem solving.

## II. RESEARCH METHOD

We use Research & Development (R & D) to develop the instrument of cognitive assessment based taxonomy bloom. Research and development is a process used to develop a product research which has the good quality by measured validity, reliability and etc [9]. The subject of this research is product of cognitive assessment that develop based revised taxonomy Bloom.

The steps of R&D from Borg and Gall [10] which have modify:

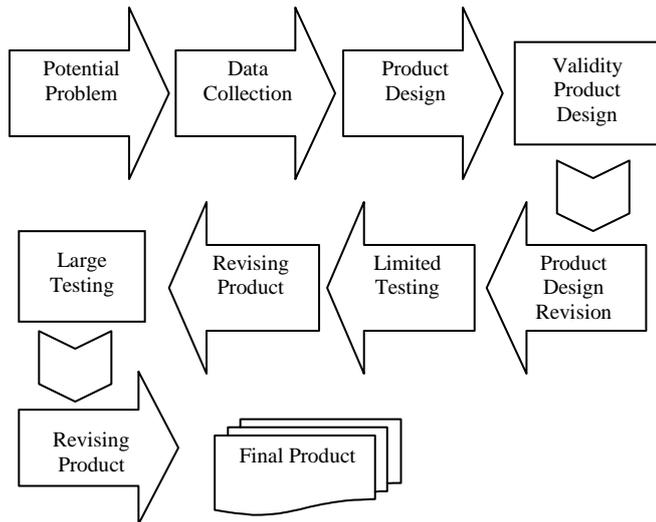


Fig. 1. Steps of R&D from Borg and Gall

A. Potential Problem and Data Collection

The technique is observation on the cognitive assessment in quadrilateral topic, then had an interview with junior high school teachers about the assessment. The problem is the level of assessment which does not draw students' aptitude from revised taxonomy Bloom, especially C4, C5 and C6. Collecting data to develop the instrument is from many sources about the quadrilateral topic for 7<sup>th</sup> grade student, focus on square and rectangle, and also the assessment at the topic.

B. Product Design

The design of the assessment is by making question based on Competency Standards (SK), Basic Competency (KD), Core Competence (KI) and work word from revised taxonomy Bloom at modification from table 1 and answer key, which will be assessed on cognitive aspects on the subject of as many as four meetings. Then, the product will be validated by 5 validators who have skill in mathematic cognitive assessment, and every aspect (language and content) which exist at validation questionnaires must be revision by the research. The questionnaire analyzed through qualitative and quantitative analysis. Qualitative analysis had four general marking namely 1) Can be used without revision, 2) Can be used by less revision, 3) Can be used by many revision and 4) Cannot be used. Then, quantitative analysis had two categories namely suitable with the aspects which has score 2 and not suitable yet with the aspects has score 1.

From the sum of scores it can be known of the criteria for every question shows on the Table I

C. Limited Testing

The limited testing is held for 6 students who had known about the topic of square and rectangle, in 2 schools on 8<sup>th</sup> and 9<sup>th</sup> grade junior high school. The purpose is to know that the question can be understand by students, and also has not multiple interpretations. Then, research interviewed the

students about the question that they can not be understand, and get revision for that.

TABLE I. VALIDITY CATEGORY

No	Sum of Score	Validity Category	Explanation
1	13.00-14.00	Not valid	Ca not be used
2	15.00-17.00	Less Valid	Banned for used
3	18.00-20.00	Valid enough	Can be used by many revision
4	21.00-23.00	Valid	Can be used by small revision
5	24.00-26.00	Very Valid	It is good for used

D. Large Testing

The one of characteristics R & D is field testing it in the setting where it will be used eventually, it means design product [9]. The large testing will be held on one class of 7<sup>th</sup> grade for one Junior High School that consist of 28 students in 2015. After the testing, we can find the rank of the effectiveness, by formula:

$$X = \frac{\text{total of completed students}}{\text{total of students}} \times 100\%$$

Then after the final revision, the research can get a final product for the square and rectangle topic.

III. RESULTS AND DISCUSSION

The one of benefit of this assessment is to help teacher in order to identify the students' cognitive level and whether it was in suitable with teachers' expectations regarding in Bloom taxonomy for a specific material [2]. Following the method from the modification in this article, four questions will be discussed. The revised taxonomy Bloom at C4, C5 and C6 to be used to develop the questions.

A. The Validity of Design

The design of the cognitive assessment consists of three kind questions, such as group exercise, self-exercise, and quiz. The construct is using the work words for the level of cognitive in indicator of the question and appropriate level of knowledge [7].

Those are many suggestions from validators on first validation (Validation I) process as following:

- a) Adjust the problem with the actual reality in everyday life,
- b) Add a review for the plane is in question more clearly,
- c) Check whether or not logical given problem,
- d) Adjust the image given in order not to cause misinterpretation,
- e) The number of questions do not need too much,
- f) Improve indicators about and adjust to the matter in questions,
- g) Avoid questions that have same level of cognitive level in each meeting.

Then, the suggestions from validators on second validation (Validation II) process as following:

- a) Add a caption on an image, so that question information become clear,

- b) Fix the language in order to help student easy understanding by students,
- c) Select an appropriate image that can avoid students' misinterpretations.

All of the validators in validity I give the general marking C and B which mean the designs need to have many and few revision, same as the scores that gets valid in 21.00-23.00 with the small revision. Then, after the revision, the validators give the general marking A and B, that can be use without revision again, same as the score that "very valid" in 24.00-26.00.

**B. Revision of Limited Testing**

By interviewing, we got the revision after the limited testing:

- a) students were not familiar with open ended questions,
- b) there were many interpretations about the questions,
- c) there were questions that need analysis and representation skill.

Based on the results of students' scores and interview the students on a matter that ca not be understood. Then, the revisions of the research are following:

- a) Some of the problems that present in image on quiz is replaced with another image that can be imagined by students.
- b) At the unimaginable, then the problem is eliminated for reducing amount of matter that too much.
- c) Open Ended Questions continue to be used to reach the levels of Bloom is taxonomy matter at C6 (create) [8].
- d) Language that is difficult to be understood by students, researchers will change based students in a language that can be understood.

**C. The effectiveness**

Measuring the education (teaching and learning), by the design of measurement is very important for used [1]. Then the best instrument can be produced by validating and find the effectiveness.

By the formula from Chapter III to find the effectiveness value, the large testing held in one class at one school for 28 students, the results were:

**1) Group exercises**

At the time of completing the question number 1, the students sketched in charge by adding the contents above the square as well as the analysis of the students in the picture then, about the number 2 is still insufficient, especially determining the size of the portion of known size. Researchers conducted a revision in the problem that the language is easier to understand the students, because a lot of misinterpretation on Question 1. Researchers to revise their images and language, based on advice from the observer on Question 2 (picture) and Question 1 (language).

All data based the recently research [12].

The note from the not effective exercises:

- a) The students misunderstanding with the picture, not the language (Quiz I)

- b) The students are not familiar with the question, and short time, and also the number is not round (Self exercise II)
- c) There is misconception about the purpose of the question, because of language (Quiz II)
- d) The students unless understand the introduction of the question (Quiz III)

TABLE II. QUIZ AND SELF EXERCISES

Meeting	Question	Total of complete students	Effectiveness	Criteria
I	Self exercise	19 students	70%	Effective
	Quiz	11 students	40%	Ineffective
II	Self exercise	6 students	25%	Ineffective
	Quiz	11 students	45%	Ineffective
III	Self exercise	24 students	88%	Very Effective
	Quiz	6 students	22%	Ineffective
IV	Self exercise	12 students	66%	Effective Enough
	Quiz	13 students	72%	Effective

**D. Final Product**

All the process of the researching already done, after the large testing, we can get the revision and the final product of the cognitive assessment, and these are some of question:

- 1) Material : Square  
 Level of Cognitive : C4  
 Level of Knowledge : Procedural  
 Basic Competency : Identify the properties of square plane and use it to determine the circumference and area.  
 Indicator : Given the form of a square-shaped cake images that will be placed on a more square, students can categorize the form of images, analyzes the size of the rendered image.

On a rectangular cake pan, Ruth wanted to prepare 16 pieces of cake in which the first piece of cake measuring 5 cm x 5 cm (rectangular):



Fig. 2. a) Cake pan; b) Cake

The cake will be prepared in the pan with the provisions of each side of the pan can be charged with four cakes without distance. Draw sketches along with cake pan that covers the entire surface of the pan on top of it! Draw sketches along with cake pan that covers the entire surface of the pan on top of it! What is the size and extent of the cake pan?

- 2) Material : Square and Rectangle

Level of Cognitive : C3, C5, C6  
 Level of Knowledge : Procedural, Conceptual, Metacognitive  
 Basic Competency : The properties of rectangular and square.  
 Indicator : Given a pizza that consists of two types of shapes (square and rectangular), students can determine the diagonal line dividing the pizza, interpreting differences of the large pieces and can create the cut line dividing the rectangular shaped pizza in order to obtain equal parts.



Fig. 3. Three boys will eat pizza in two choices of pizza that will be divided into 4 parts.

The surface side of picture A is a rectangle and the surface side of the image B is a square.

- a) Make a sketch! Which image that can not be divided by 4 equal parts using a diagonal line?
- b) Based on the answers a), why these images cannot be divided by 4 equal parts? Explain your reasoning based on the properties of the flat wake!
- c) If the image can be divided four equal parts without a diagonal line, make a sketch in your opinion!

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