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Student Profile in Completing Questions Based on Cognitive Level of Bloom's Taxonomy By Anderson and Krathwohl

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Abstract. This study aims to identify the ability of students in completing questions based on cognitive level of Bloom's Taxonomy by Anderson and Krathwohl of the process evaluation and learning outcomes. The subject of this research is 6th semester students, chemistry education department, Islamic University of Indonesia. This research is a descriptive research. The study was conducted using the test instrument about the process evaluation and learning outcomes based on indicator of bloom's taxonomy are Lower Order Thinking Skills (LOTS) consisting of remembering, understanding and applying then for the Higher Order Thinking Skills (HOTS) consisting of analyzing, evaluating and creating. The test instrument is essay about development and analysis of assessment instrument in process evaluation and learning outcomes. The results show that based on the data obtained can be described on the Lower Order Thinking Skills (LOTS), the ability of students to working out questions at the level of remembering reached 76.67% "good category"; at the level understanding 73.33% "good category" and at the applying level of 62.22% with the "good category". While the students' ability in working out questions on High Order Thinking Skills (HOTS) at the level of analyzing level 58.52%, at evaluating level reached 53.78% with both of them "enough category" and at creating level reached 72.44% "good category"

INTRODUCTION

In a lesson we often conclude that a student's learning achievement can be judged on the basis of their final grade. However, in a lesson there is really something to be examined more deeply in the "process" that is done during learning. This learning process can include approaches, strategies, methods, models, and even evaluation tools used. Matters associated with the learning process is the most important factor in achieving a learning objective and some of the above is included in the external factors in the learning process. Achievement of learning objectives is not only influenced by external factors alone, but internal factors are also important to the success of learners. One of the internal factors that affect the achievement of learning objectives is the ability to think.

The ability to think is one of the fundamental things in the education process. One's thinking ability can affect learning ability, speed and effectiveness of learning. Therefore, thinking skills are associated with the learning process. Students who are trained to think show a positive impact on the development of their education [1]. Teaching and learning activities should involve explicit thinking skills, making it easier to categorize thinking skills based on existing frameworks [2].

Bloom's Bloom's Taxonomy is designed to differentiate thinking skills from the lowest level to higher-order thinking [3]. Then Anderson and Krathwohl (2001) revise this taxonomy by classifying six cognitive processes whether students are able or learning to: (1) remember, (2) understand, (3) apply, (4) analyze, (5) evaluate and (6) create [4]. Like the original framework, the new taxonomy assumes the underlying sustainability of cognitive processes becomes more complex. Bloom's Taxonomy can help educators to recognize whether there is an inconsistency between what the learning objectives are and what the teacher wants based on what is implied from the questions that the teacher gives to the students [5]. Bloom's Taxonomy shares learning objectives as lower order thinking and higher order thinking and explains that one of the six behaviors that educators can hamper students' learning is the use of lower-order thinking questions on the instrument of learning evaluation, and if the questions

asked by the teacher still focus on the questions at that level then the students' thinking will also be fixed on this level [3,4,6]. Therefore, it is important to know whether the questions contained in the questions given by teachers can develop students' thinking on various levels of cognitive.

According to minister education and culture's regulation in Indonesia [7], the assessment of study result by educator is information or data collecting process about student's achievements in attitude aspect, knowledge aspect, and skill aspect which is done systematically to observe the process, study progress, and study result improvement by giving an assignment and evaluation of study result. To develop the ability to think critically, there are five lessons that can be taken, namely: (1) determine the learning objectives, (2) teach through inquiry, (3) practice, (4) review, refine and improve understanding, and (5) practice feedback and assess learning [8]. According Krathworl (2001) indicators to measure the high-level thinking skills include: analyzing, evaluating, creating. Thus, HOTS is a thinking skills that not only requires the ability to re-member, but also other higher capabilities include the ability to analyze, evaluate, and create [4].

Classifies bloom's thinking skill into two categories that is Lower Order Thinking Skills which consists of knowledge, understanding and application [9]. Higher Order Thinking Skills which consists of analysis, synthetic and evaluation. Description and key word of each category can be seen in Table 1.

TABLE 1. Description and Key Word of Bloom's Taxonomy Revision

Category	Key Words
Remembering: can the student recall or remembering the information?	Mention the definition, imitate the pronunciation, state the structure pronounce, repeat state
Understanding: Can the students explain the concept, principle, law or procedure?	Classify, describe, explain the identification, placed, report, explain, translate, paraphrased.
Applying: Can the students apply their understanding in new situation?	Choosing, demonstrating, acting, using, illustrating, interpreting, arranging schedule, making sketch, solving problem, writing.
Analyzing: Can students classify the sections based on their difference and similiarity?	Examining, comparing, contrasting, distinguish, doing discrimination, separating, test, doing experiment, asking.
Evaluating: Can students state either good or bad towards a phenomenon or certain object?	Giving argumentation, defending, stating, choosing, giving support, giving assessment, doing evaluation.
Creating: Can students create a thing or opinion?	Assemble, change, build, create, design, establish, formulate, write.

In Bloom's taxonomy, there is only known one cognitive domain but in Anderson and Krathwohl's taxonomy become two dimensions. First dimension is Knowledge Dimension and Cognitive Process Dimension. Anderson and Krathwohl's two dimensions perspective for higher order thinking and classification of its operational verbs can be described in Table 2.

TABLE 2. Blooms' Taxonomy of Dimentional Revision and Examples of Operational Verbs for Higer Order Thinking

The Knowledge Dimension	The Cognitive Process Dimension		
	C4 Analyze	C5 Evaluate	C6 Create
Factual Knowledge	Making structure, classifying	Comparing, correlating	Joining
Conceptual Knowledge	Explain, analyze	Examine, interpret	Planning
Procedural Knowledge	Distinguish	Conclude, resume	Arrange, formulate

Source: [4]

RESEARCH METHODS

1. Design Research

This research was Descriptive quantitative. Descriptive quantitative research is research that seeks to describe a symptom, events and happenings that occur at the present time in the which research tried to take photo, picture, or figure of events and happenings that become the center of attention for a later described as such. [10]

2. Research Subjects

Subjects in this study are students of chemistry education, Islamic university of Indonesia. Subject in this study consisted of nine students, divided into 2 of two males and six females. This research is conducted on Evaluation and student learning process course.

3. Research Procedure

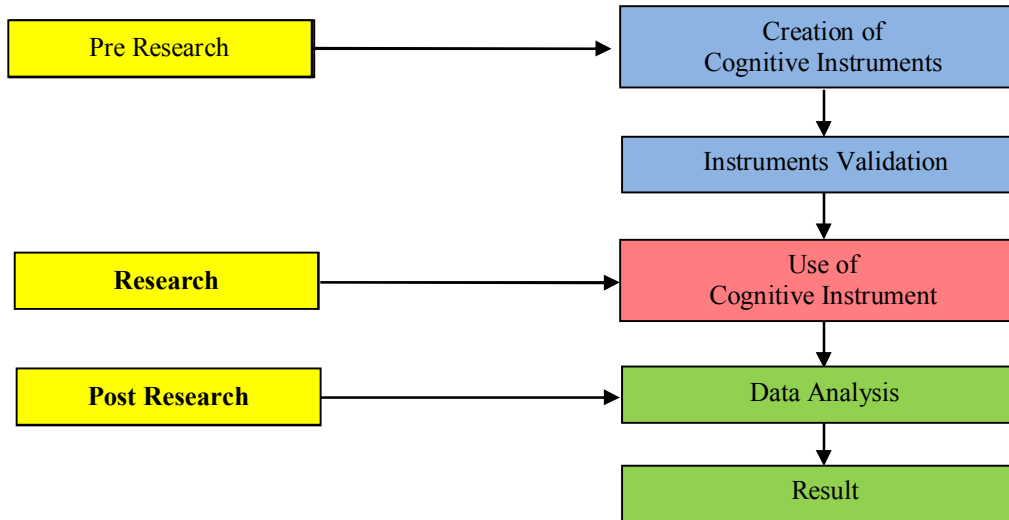


FIGURE 1. Research Procedure

4. Research Instruments

Data collection in this research using test instrument. The test instrument is a description of six questions. The questions of the description fall from six levels according to Taksonomy bloom (1) remembering, (2) understanding, (3) applying, (4) analyzing, (5) evaluating and (6) creating. Each question represents each level. Problems that have been made later in the validation by experts. Results from expert validation will be analyzed using gregory formulas. The questions and descriptions of the questions can be seen in Table 3. below.

TABLE 3. Indicator Descriptions of Instrument Assessment

No	The purpose of students's achievements	Indicator	Cognitive Dimension
1	Able to know the basics of making instruments	Mentions the steps in making the instrument	C1
2	Able to identify the instruments used in accordance with the research to be conducted	determine the instruments used from a research title	C2
3	Able to determine the correct instrument and can be used for assessment	Calculates the validity of an instrument	C3

TABLE 3. Indicator Descriptions of Instrument Assessment (*Continued*)

No	The purpose of students's achievements	Indicator	Cognitive Dimension
4	Able to determine the correct instrument and can be used for assessment	Analyze data from research results	C4
5	Able to determine the correct instrument and can be used for assessment	Analyze and interpret data from research results	C5
6	Able to design the research and instruments used appropriately	Create research instruments	C6

Note: C1 (Remembering); C2 (Understanding); C3 (Applying); C4 (Analysis); C5 (Evaluation); C6 (Creation)

5. Data Analysis Techniques

Instrument Validation Results

The results of the validation instrument gregory of cognitive test using the formula presented in Table 4. below.

TABLE 4. Summary of Results of Content Validity Cognitive Test Instruments

Variable	The number of Indicator	CV	Conclusion
<i>Cognitive test</i>	6	0,8	Analysis can be continued

6. Results of Cognitive Test Score

The results of the score of posttest based on cognitive dimension presented in Table 5 below. Data obtained then processed by using the formula percentage Arikunto as follows. The percentage values of occurrences are then grouped by category as follows: 81-100% percentage is categorized by predicate: Very Good; 61-80% (Good); 41-60% (Enough); 21-40% (Less); and the percentage of $\leq 21\%$ is categorized as less than once [11].

$$\% \text{ Occurrences} = \frac{\sum \text{average (the emergence of certain aspects)}}{\sum \text{Overall Aspect (scores)}} \times 100\%$$

TABLE 5. Descriptive on cognitive test score

The number of questions	Cognitive Dimension	Maximal Scores	Average	Presentation of cognitive achievement dimension (%)
Question 1	C1	10	7,67	76,67
Question 2	C3	15	9,33	62,22
Question 3	C4	15	8,78	58,52
Question 4	C5	25	13,44	53,78
Question 5	C2	10	7,33	73,33
Question 6	C6	25	18,11	72,44

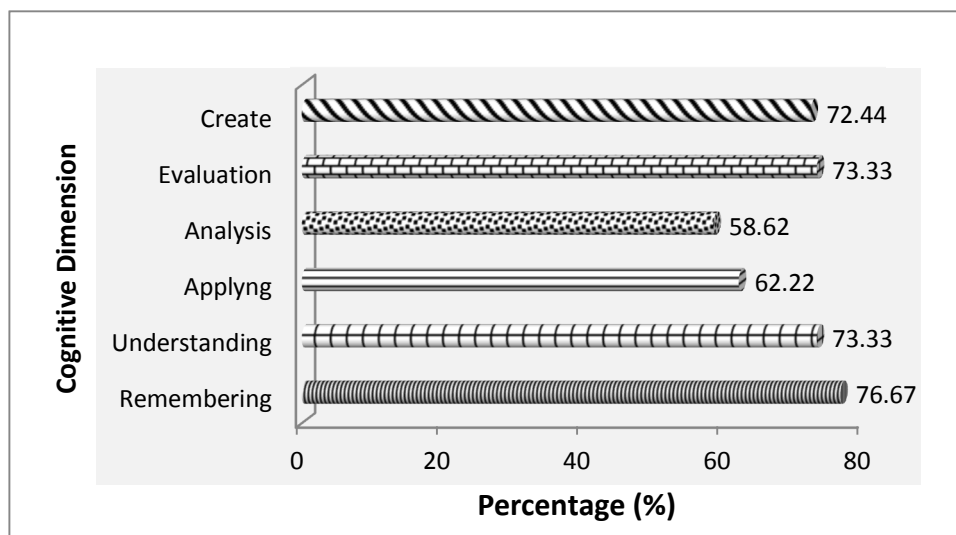


FIGURE 2. Histogram of Percentage Cognitive Dimension (Level) Taxonomy Bloom by Anderson and Krathwohl to Completing Questions

RESULTS AND DISCUSSION

The results showed that assessment instruments developed based on the cognitive level of C1-C6 can be used. The form of assessment used is a matter of description. Problem description consists of six questions, where each problem represents the developed cognitive dimension. Problems before being used are validated to experts through content validation. Results from content validation to experts have been presented in Table 4. The calculations used for content validation by experts using gregory formulas and obtained a number of 0.8 which can be concluded that the instrument can be used.

Furthermore, validated instruments have been used to collect assessment data on evaluation courses and learning outcomes in chemical education students. Based on the results of the research presented in Table 5, the achievement for each cognitive dimension varies. Highest student ability and able to do problem at level of matter with cognitive dimension C1 equal to 76,67% with category "Good". Next on C2 is 72,33% category "Good"; C6 of 72.44% category "Good"; C3 of 62.22% category "Good"; C4 of 58.78% category "Enough" and the lowest obtained C5 of 53.78% category "Enough".

According to Bloom et al. (1956) memorization is the lowest level of thinking ability (Thinking Behaviors) and this ability must be mastered before it can increase at the next level of thinking [2]. The next level of thinking is understanding and application. Remembering, understanding and application is still classified as Lower Order Thinking (LOTS). The results showed that in the lower order thinking level, the students were able to solve the problem well and able to achieve the "Good" category. This indicates that at the level of C1 (memorization), C2 (understanding), and C3 (Application) can be understood by students so that students should be able to continue on the next cognitive level called higher order thinking (HOTS) that is C4 (analysis) C5 (evaluation) and C6 (create). However, in this study showed that the results of student skills on HOTS cognitive dimension have not been able to measure as expected. In C6 students have a good achievement presentation of 72.44%. This can be said to be quite high compared to C4 and C5 which only get the category "enough".

Whereas students should have skills on cognitive dimension C4 and C5. In these questions students are required to think complex. The skill for complex thinking is a necessary skill in critical thinking, and teachers should teach their students to make decisions based on critical thinking so that the student can improve his or her future and contribute to society [12]. The findings of some educational observers indicate that the tendency of learning in Indonesia only exposes facts, knowledge, and laws, to then discourage and not attempt to link the content learned with everyday life, thus causing students to experience the greatest difficulty in applying the knowledge that owned in real life [13, 14].

As mentioned earlier, Facione (2015) emphasizes the importance of teachers to develop students' critical thinking skills in order to contribute to society [12]. This suggests that efforts to develop high-level skills such as critical thinking skills are crucial, not only increasing the value of Indonesian students' learning skills at the global

level, but rather on preparing students when they have graduated from school and become part from both local and global communities. Learning strategies that can develop students' critical thinking skills are strategies in which teachers practice skills development strategies higher order thinking [15].

CONCLUSION

Students' mastery of problem-solving based on cognitive level of Bloom's taxonomy revision was found in different percentages, the mean of cognitive lower order thinking (C1, C2, and C3) cognitive level emergence was "good" while the cognitive level higher order thinking (C4 and C6) are "enough" but in C6 have "good" category.

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