*Advances in Social Science, Education and Humanities Research, volume 118*
9th International Conference for Science Educators and Teachers (ICSET)

# Primary School Teacher Education Students' Cognitive Ability in Solving Mathematical Question

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***Abstract***

The study and the result was aimed to describe primary school teacher education students' cognitive ability in solving mathematical question. This study used descriptive quantitative approach. The result of the study showed that students' ability in solving mathematics question based on Bloom's taxonomy. The result showed that 72.5 % students achieved understanding level. The rest of them achieved higher order thinking level. It showed that students' cognitive ability at that level should be increased. One of the effort to increase it could be by giving varied mathematical questions based on Bloom's taxonomy while lecturing.

Keywords: cognitive ability, students ability, mathematical question

## 1 INTRODUCTION

Law No. 14 of 2005 on Teachers and Lecturers [1] mentions four teacher competencies, including pedagogical competence, personality competence, social competence, and professional competence. One part of the professional competence of elementary / junior high school teachers, namely the mastery of materials, structures, concepts, and scientific thinking patterns that support the subjects. The translation of such competence in mathematics subjects, among others (20.7), mastered the conceptual and procedural knowledge as well as the relevance of both in the context of arithmetic, algebra, geometry, trigonometry, measurement, statistics, and mathematical logic; (20.8) are capable of using horizontal and vertical mathematization to solve math problems in the real world; (20.9) are able to use conceptual, procedural, and interrelated knowledge both in mathematical problem solving and its application in everyday life; And (20.10) able to use props, measuring instruments, calculators, and computer software [2].

Thinking mathematics is a dynamic process that seeks to understand the pattern that exists, both from the natural world, and from the mind [3]. As a process, mathematical thinking is associated with a cycle of cyclic activity that bridges the cognitive and affective domains. The cognitive domain in the thinking process is closely related to the process of cultivating knowledge and developing intellectual ability. The cognitive domain is clearly described in Bloom's taxonomy.

Bloom's taxonomy was developed by cognitive psychologists, Dr. Benjamin Bloom in 1956 and revised in 2001. This taxonomy is a classification of skills that can be viewed as the goal of learning [4]. Bloom in 1956 classifies the cognitive thinking into six levels of thinking skills, namely: (1) knowledge, (2) comprehension, (3) application, (4) analysis, (5) synthesis, and (6) evaluation. While the revised taxonomy of Bloom in 2001 [4] to replace the points (1) remembering, (5) evaluation, and (6) create.

Bloom's revised taxonomy by Lorin W. Anderson, Krathwohl, and other cognitive psychologists in 2001 underwent a change in the cognitive domain. Cognitive domains after revision [4] include: (1) remember, that recall information that has been taught previously, (2) understanding, namely understand the meaning, translation, interpolation, and interpretation of the problem, (3) applying, using a concept in a new situation, (4) analyzing, which describes a concept into its elements and determine the connection between them, and (5) evaluating, namely making decisions or judgments about an idea or material, ( 6) creating, rearrange the structure or pattern of different elements, bringing the parts together into a single new or have a new structure.

As primary school teacher candidates, Primary School Education students should understand learning approach [5] and master the six levels of mathematical thinking ability as mentioned above.

This is because in Bloom's taxonomy, every level can be achieved if the previous stage has been mastered. In fact, the level of mathematical thinking ability in each student is different from each other. This is due to differences in previous cognitive abilities students gain on learning at the secondary level. How students thinking about the subject influence their understanding into the subject [6].

Knowledge of lecturers about students' cognitive ability level has an important impact on learning. This is related to the selection of learning strategies and materials to be presented in the lecture process. Lecturers 'knowledge of students' cognitive abilities can also help to improve other mathematical skills, such as mathematical communication skills [7].

The purpose of this research is to describe the mapping of cognitive ability of Primary School Teacher Education' students in solving math problems. Cognitive abilities of students are classified according to Bloom's taxonomy revised, namely C1 (remembering), C2 (understanding), C3 (applying), C4 (analyzing), C5 (evaluating) and C6 (creating).

Mathematical questions are based on three main subjects in mathematics, algebra, arithmetic, and geometry. The achievement of the cognitive abilities of Primary School Teacher Education' students is determined by the average of correct answers to the questions at each stage of Bloom's taxonomy. Primary School Teacher Education' students are said to reach a stage, if the average reaches 50% or more at that stage and the previous stages.

## 2 METHODS

The research conducted and the results obtained are intended to describe the mathematical thinking stage of Primary School Teacher Education' students in solving arithmetic problems. This study uses a quantitative approach, namely data collection aimed at generating data in the form of quantities or in the form of statistics [8]. The type of research used in this research is descriptive research. The data collected in this study is descriptive that explains the percentage of students' cognitive abilities in solving arithmetic problems based on Bloom's taxonomy (C1 to C6).

Data were collected from 33 questions divided into 9 questions C1, 6 questions C2, 6 questions C3, 6 questions C4, 3 questions on C5 and 3 questions on C6. Students 'work results are analyzed and students' cognitive abilities can be produced in completing mathematics at each stage.

## 3 RESULT AND DISCUSSION

This research involves 80 students of Primary School Teacher Education, covering 36 students of class of 2014 and 44 student of class of 2015. At the C1 stage, out of a total of 9 questions with numbers 1 through 9, 19 students were able to answer 5 questions correctly, 16 students answered 6 questions correctly, 5 students answered 7 questions correctly, and 4 students were able to answer 8 questions correctly. However, there are no students who can answer 9 questions correctly.

At stage C2, out of a total of 6 given questions, with numbers of 10 to 15, 24 students were able to answer 5 questions correctly, 23 students answered 4 questions correctly, 16 students answered 3 questions correctly. At this stage there are 14 students who can answer 6 questions correctly.

At the C3 stage, out of a total of 6 questions with numbers of 16 to 21, 22 students were able to answer 2 questions correctly, 19 students answered 1 problem correctly, 19 students answered 1 problem correctly, and 9 students were able to answer 4 questions correctly. At this stage no student is able to give correct answers for 5 or 6 questions.

At the C4 level, out of a total of 6 questions with numbers of 22 to 27, 23 students were able to answer 2 questions correctly, 19 students answered 3 questions correctly, 15 students answered 4 questions correctly, and 3 students were able to answer 5 questions correctly. However, there are no students who can answer 6 questions correctly.

In stage C5, it consists of 3 questions with numbers of 28, 29, 30. At this stage, there are 29

students who are able to answer 1 question correctly, 11 students are able to answer 2 questions correctly, and 3 students are able to complete the three questions correctly.

In stage C6, it consists of 3 questions with numbers 31, 32, 33. At this stage, there are 27 students who are able to answer 1 question correctly, 14 students are able to answer 2 questions correctly, and 1 student who is able to solve the three questions correctly.

The test results also illustrate the cognitive abilities of students in each material, namely arithmetic, algebra, and geometry. An overview of students' cognitive abilities in solving math problems in each material is shown in the following diagram.

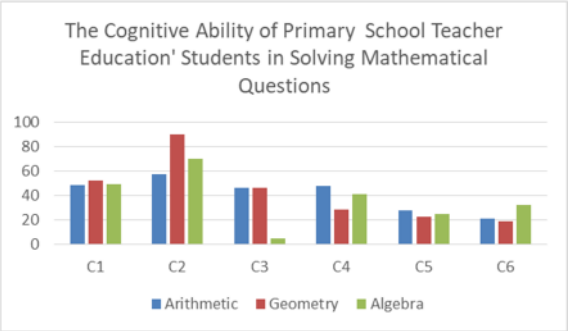


Figure 1. Analysis of Primary School Teacher Education' Student Cognitive Ability on Each Subject

In the diagram above, it can be seen that in stage C1 and C2 students are able to solve mathematical problems related to geometry and algebra better than arithmetic problem. At stage C3, students are able to solve arithmetic and geometry problems better than algebraic problems. At this stage algebraic mastery is at the lowest level because it is controlled only by 5% of students. In the C4, C5 and C6 stages, students are able to solve arithmetic and algebra problems better than geometry.

Primary School Teacher Education students' cognitive abilities at each stage according to Bloom's taxonomy shows that students reach a stage C2 (understanding / understanding). This ability can be seen from the average student reaches 50% at C1 and 72.5% in C2, meanwhile in C3, C4, C5 to C6 the student average is below 50%.

Based on data exposure, it is known that the average cognitive abilities of students at C1 is 50% and C2 is 72.5%, while in C3 to C6 the student is still below 50%. These results indicate that most students have been able to remember and understand mathematics on algebraic materials, arithmetic and geometry that they have learned. While the competence to apply to formulate, the ability of Primary School Education students still tend to be low. This is in accordance with [5] research results which reveal that mathematician candidates have sufficient cognitive ability to remember and understand and explain the approach they have learned. However, cognitive competence in applying and comparing the approaches they study tends to be low.

Based on the mapping of cognitive ability of Primary School Teacher Education' students, it is found that students have average ability less than 50% in cognitive stage of C3, C4, C5, and C6. Students' mastery is influenced by many aspects, one of which is the initial ability of students. The mapping of cognitive development in 2013 [9] gives an overview of the cognitive development of Primary School Teacher Education' students of class 2015 and 2014 which at that time was still in high school. It revealed that most students have cognitive development that has reached formal operational stage [9]. However, the cognitive development of high school students related to mathematical abilities, both male and female, is at a level of insufficient, insufficient, and even low based on logical operational criteria according to Piaget.

In addition to cognitive development, other factors that affect the cognitive abilities of students related to mathematics is the ability to think mathematically. The ability to think mathematically includes the ability to think critically. Another research points out the fact that students' critical thinking skills in the Mathematics department are at a critical level and most of them show a low critical level [10]. These results require follow-up in the form of efforts to improve students' critical thinking skills.

The average tenure of students that are low on the load level thinking about the high level / higher order thinking (C4, C5, and C6) demonstrate the need for learning strategies to enhance the ability of the student. It connects with the research that found learning using the right learning strategy can improve student learning outcomes in the cognitive domain according to levels in Bloom's taxonomy [11].

The cognitive abilities of Primary School Teacher Education' students can support mathematical communication skills [7]. As a prospective teacher, students need to be equipped with mathematical communication skills in the form of ability to convey ideas, ideas related to solving math problems. As a continuation of this research, it is necessary to develop an instrument that supports students in demonstrating their mathematical communication skills.

# 4 CONCLUSION AND RECOMMENDATION

## 4.1 Conclusion

Based on the data analysis, the students' cognitive ability in solving mathematical question reached the understanding stage (C2) with the criteria at the recall (C1) of 50% and the understanding (C2) of 72.5%. At the higher order thinking, as much as 39.2% of the students reach the cognitive stage C4, 25% of students reaching the C5 stage and 24.2% of students reached the stage of C6. This suggests that students' cognitive abilities especially at higher-order thinking levels need to be improved. Efforts to improve students' cognitive abilities can be gained by varying questions related to Bloom's taxonomy in lectures.

## 4.2 Recommendation

The results of this study provide information related to students' cognitive abilities based on Bloom's taxonomy. Information obtained can be used as a reference in the development of learning in Primary School Education courses, especially in learning mathematics. Giving questions varies in lectures related to the field of mathematics study is highly recommended for the development of students cognitive ability especially at higher order thinking.

Research instruments can also be developed to look at students' mathematical abilities in addition to the cognitive domain. Further research can be directed to develop efforts to improve students' skills related to mathematics, as well as other fields of study on Primary School Education courses.

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