Logical thinking skills of prospective elementary school teachers

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Abstract. A teacher should present a lesson concept well, not just only using it to solve a question on exams. However, the teacher should make their students understand all of the concepts. This thing should be built since we are in a golden age or elementary school. Elementary school teacher should have better skills in teaching, because they teach a lesson base, especially mathematics. If students do not understand the base of mathematics, they will not be able to solve more complex mathematics problems. Therefore, logical thinking skill is needed for this, especially for an elementary school teacher. This research aims to see whether students of prospective elementary school teacher have a good logical thinking skill or not. To do so, we used the descriptive qualitative method. We presented an easy mathematics questions to see their logical thinking skills. The result shows that prospective elementary school teacher students did not have good logical thinking skills yet. They still should increase their logical thinking skills to be a better teacher. Their lecturer should have a better teaching concept to make a better elementary school teacher later.

1. Introduction

Elementary school is a formal education level that can determine how a child’s characteristics are built. Children’s abilities began to build in this formal education level, from their cognitive until affective, which will affect their mindset later. This task is certainly not easy for primary school teachers. They are the ones who have an important role to build all of the children’s characteristics and make them ready to face their life problems. Furthermore, a primary school teacher should be clever in the learning process, especially in forming aspects.

In building children’s characteristics process, it certainly needed good and accurate strategies. The strategies should be prepared carefully, starting with teaching materials, teaching methods, and many more. Determination of these things must go through considerations carefully thought out too, from students’ abilities, student responses, students’ will, and many things. The factors that influence students are taken into consideration to make this strategy so that it can be good and right. The ability to support a good and appropriate approach is the ability to think logically.

Piaget mentions in his theory that a person will go through several stages of cognitive development [1–7]. The sensorimotor stage occurs at 0-2 years of age, where they adapt to the surrounding environment and try to understand what they feel. Then the pre-operational stage occurs at the age of 2-7 years, where they can reason and practice their logical abilities. They use objects and symbols to represent something that is in a concrete form. After that, the concrete operational stage occurs at the age of 7-11 years, where they use a logical reasoning process. And the last stage is the formal operational stage that occurs at the age of 11 years to adulthood, where they think not only abstract but has become
logical. The ability to think logically is included as a characteristic of the last two stages of cognitive development theory carried out by Piaget [8].

The ability to think logically is a thinking process that uses mathematical reason and logic consistently so that an expected conclusion is obtained [9,10]. This ability is needed not only to make good and just strategies but also in solving problems in daily life as well [11–15]. If someone has good logical thinking skills, then he can solve his problems well. This ability should have been developed early when someone entered the golden age, especially at the elementary school level. However, it is not easy to develop one's logical thinking skills. Many factors can influence the formation of one's logical thinking; one of the most influential is the teacher.

If a teacher wants to teach something or convey something, certainly must master the things that want to be conveyed, as well as the ability to think logically, how teachers can develop their students' logical thinking skills if the teacher has not mastered or has good logical thinking skills. Therefore, every teacher must have good abilities, especially teachers at the elementary school level. They will need more effort in building the character of their students.

One study was written in Anriani [16] states that the low ability to think logically from some junior high school students is influenced by the teacher, the learning process of the students is too focused on the procedure of how they solve a given problem, not on understanding the concept. Many such phenomena occur, especially in the elementary school level. Preliminary research conducted by us before by interviewing elementary school teachers found that there were still several teachers in the learning process as in the case above. This makes students only understand how to work on the questions given, not how the concept is understood. So that students' logical thinking skills do not develop and tend to be at a low level.

Therefore, to avoid such a thing, it is expected that teachers can have good logical thinking skills since before they were appointed as teachers since they first entered college. Prospective teachers are not only required to master the concept of a subject, but also must be able to be an example for their students so that later the children who are educated can be better, whether in intellectual or behavior and attitudes. Several studies were conducted to find out the criteria for good teachers.

Darling-Hammond and Baratz-Snowden [17] explains there are seven things about how effective teachers are, including using various assessment tools, organizing activities and instructions based on students' abilities, making students interested in the learning process, conveying hope to students, presenting constant feedback for student development, sounding good class management, and collaborating with parents of students. Then Hattie [18] underlines five elements that distinguish good and not teachers, good teachers can identify essential representations of their subjects, guide learning through interaction in class, monitor learning and prepare feedback, follow effective attributes, and influence student outcomes. There is another study conducted by Reichel & Arnon [19] which mentions several categories of teachers based on teaching knowledge, people who have values, and the relationship between teachers and students.

Whereas according to Gao & Liu [20] there are six categories of teachers, namely teacher knowledge is material and how to teach, professionalism, versatile class performance, relationships with students, can motivate students, and personality. Based on some of the categories above, Bergman [21] concluded that there were 5 categories where the teacher was said to be good, namely (1) relationship/interaction with students, (2) material and pedagogical knowledge, (3) high expectations of learning, (4) using various strategies and activities, and (5) assessment and feedback for student learning. In addition to the above criteria, the logical thinking skills of prospective teachers also need to be considered to reach the categories mentioned. This study aims to see how the ability to think logically for prospective elementary school teachers. This aims to make learning for lecturers who teach these students so that the printing of prospective teachers who are better and have good logical thinking skills.

2. Method
This research is a qualitative descriptive study [22,23]. The subjects of this study were four third grade elementary school teacher candidates who had taken the basic math concepts courses. The main instrument of this study was the researcher himself with the help of the tests given to the nine students. The question given is a simple math problem, as in Figure 1.
1. Sebutkan rumus luas daerah segitiga! Dapatkah anda mengonstruksi luas daerah segitiga dari luas daerah persegi atau persegi panjang? Paparkan jawabannya anda!
2. Berapakah hasil dari \( \frac{1}{2} + \frac{1}{3} \)? Jelaskan bagaimana anda mendapatkan jawabannya tersebut!
3. Berapakah hasil dari \( \frac{2}{3} \) dibagi \( \frac{1}{3} \)? Jelaskan bagaimana anda mendapatkan jawabannya tersebut!

**Figure 1.** Simple mathematics questions

The steps in this study are as follows, (1) preparing a simple instrument, (2) giving the instrument as a test to elementary school prospective students, (3) analyzing student answers. The interview process was not carried out because we felt the answers presented had been able to represent, and we could already conclude for this study.

### 3. Result and Discussion

Tests are given to several third-level elementary school teacher candidates. Students’ logical thinking ability can be seen from how they answer the tests that have been given. Do they understand the concept or just do it. The interview process was not carried out by the researcher because according to the researcher, the answer given to the test was enough to represent what was needed by the researcher.

**Figure 2.** Student one answers

Figure 2 explains that this student 1 answers without using reasons that indicate that he understands the concept of a simple problem given. It can be seen from the answers given in number two and three about the division and fraction operations. He replied that in the distribution operation question only included the reason "I got this answer from the way multiplied and exchanged by the denominator and the numerator". The reason does not show that this student understands the concept given. Whereas for the fraction addition operation problem, he also includes the exact reason as in the division operation, where the reason does not show he understands the concept of fraction operations. And on the broad side of a flat building, he can find out how the formula for a triangle area can be found with only a square/rectangular capital. It’s just that there are no examples of other triangles in answers that can be a reference to the next concept.
Figure 3. Student two answers

Figure 3 shows the answers of the second student, where the answer is not too different from the answer of the first student. He only conveyed how the process was completed without understanding the concept given. A prospective teacher should not be like that, especially the prospective elementary school teacher.

Figure 4. Student three answers

Figure 4 shows the answers from the third student. The same is true for the first and second students, who have not been able to represent what the addition and distribution of fractions areas they work. They only work by using what they memorized for a long time, so the core concept of the material is not conveyed.
Figure 5 shows the work results of the fourth student. The procedural work of simple math questions presented is very clear; each step of the procedural work is given so that researchers become convinced that this is a procedural work only. The fourth student still did not understand the concept of a fraction operation.

All of the students do not understand what the concept of the simple mathematics questions that given is. To understand the concepts in mathematics, one of them can be done by identifying what is known and what is sought from the problem at hand, then connecting the existing variables to obtain new variables [7,24–28]. By doing this, students can do planning in solving problems [29]. Uncovering the results of this study which showed that all students used as research subjects were obtained that the logical thinking skills of prospective elementary school teachers not good enough. They need improvement from their lecturer. This research also to make better assessment tools and learning process for their lecturer.

4. Conclusion
Students of prospective primary school teachers do not have good logical thinking skills. In working on a simple math problem, it can be seen that they only respond with what they have known for a long time. This does not show that they understand the whole concept used. This phenomenon often occurs, and later, this event will be handed down to the younger generation and more and more people whose logical thinking skills are inadequate and unable to make developments in the country. As for some things that, according to researchers, are very crucial and important in data collection that should be done, namely interviews. We did not conduct interviews because we felt and had enough to take the data. However, they should be interviewed to get more accurate and better data. For lecturers who teach prospective teachers, this research might be used as a reference to see how the students think logically.

References
[1] Leongson J A and Limjap A A 2003 Assessing The Mathematics Achievement of College Freshmen Using Piaget’s Logical Operation The Hawaii international conference on education pp 1–25
[2] Ojose B 2008 Applying Piaget’s Theory of Cognitive Development to Mathematics Instruction Math. Educ. 18 26–30
[3] Joubish M F and Khurram M A 2011 Cognitive Development in Jean Piaget’s Work and its Implications for Teachers World Appl. Sci. J. 12 1260–5
[4] Lubben F, Braund M, Koopman R, Scholtz Z and November I 2014 The Piaget theory of cognitive development: An educational implications Educ. Psychol. 1 9
[5] Widodo S A, Darhim D and Ikhwanudin T 2018 Improving mathematical problem solving skills through visual media Journal of Physics: Conference Series vol 948
[6] Suawangsih E, Putri H E, Widodo S and Ikhwanudin T 2018 Pengembangan Model Pembelajaran Konsep Bilangan Bagi Anak dengan Mathematical Learning Disability di Sekolah Dasar Inklusi J. Indomath Indonesia Math. Educ. 1 1–18
[7] Widodo S A, Istiqomah, Leonard, Nayazik A and Prahrmana R C I 2019 Formal student thinking in mathematical problem-solving J. Phys. Conf. Ser. 1188 012087
[8] Özdemir E and Öves F T D 2017 An Investigation into Logical Thinking Skills and Proof Writing Levels of Prospective Mathematics Teachers J. Educ. Trainning Stud. 5 1–13
[9] Artino A R J 2008 Cognitive load theory and the role of learner experience: An abbreviated review for educational practitioners Assoc. Adv. Comput. Educ. J. J. 16 425–39
[10] Sumarmo U, Hidayat W, Zukarnaen R, Hamidah and Saringingsih R 2012 Kemampuan dan Disposisi Berpikir Logis, Kritis, dan Kreatif Matematik J. Pengajaran MIPA 17 17–33
[11] Widodo S A, Prahrmana R C I, Purnami A S and Turmudi 2017 Teaching materials of algebraic equation J. Phys. Conf. Ser. 943 1–6
[12] Purnami A S A S, Widodo S A S A and Prahrmana R C I R C I 2018 The Effect of Team Accelerated Instruction on Students’ Mathematics Achievement And Learning Motivation J. Phys. Conf. Ser. 948 1–5
[13] Widodo S A 2017 Development of Teaching Materials Algebraic Equation To Improve Problem Solving Infin. J. 6 59
[14] Widodo S A, Purnami A S and Prahrmana R C I 2017 Team Accelerated Instruction, Initiails, And Problem-Solves Ability In Junior High School Int. J. Emerg. Math. Educ. 1 193–204
[15] Widodo S A and Turmudi 2017 Guardian Student Thinking Process in Resolving Issues Divergence J. Educ. Learn. 11 431–7
[16] Anriani N, Pamungkas A S, Iskandar K and Istiandaru A 2019 Improving logical thinking skills using HOTS-based mathematics teaching material J. Phys. Conf. Ser. 1188
[17] Darling-Hammond L and Baratz-Snowden J 2013 A Good Teacher in Every Classroom: Preparing the Highly Qualified Teachers Our Children Deserve Educ. Horizons 85 11–132
[18] Hattie J 2002 Teachers Make a Difference What is the research evidence? Lloydia Cincinnati
[19] Reichel N and Arnon S 2009 A multicultural view of the good teacher in Israel Teach. Teach. Theory Pract.
[20] Gao, Minghui L Q 2013 Personality Traits of Effective Teachers Represented in the Narratives of American and Chinese Preservice Teachers: A Cross-Cultural Comparison Int. J. Hum. Soc. Sci. 3 84–95
[21] Bergman D J 2018 Prospective Teachers’ Perceptions of Influential Teacher Qualities The Advocate
[22] Creswell J W 2012 Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research (London: Pearson)
[23] Creswell J W 2012 Research Design Qualitative,Quantitative,and Mixed Second Edition
[24] Widodo S A 2013 Analisis Kesalahan Dalam Pemecahan Masalah Divergensi Tipe Membuktikan Pada Mahasiswa Matematika J. Pendidik. dan Pengajaran 46 106–13
[25] Widodo S A and Sujadi A . 2015 Analisis Kesalahan Mahasiswa Dalam Memecahkan Masalah Trigonometri Sosiohumaniora J. Ilmu Sos. dan Hum. 1 51–63
[26] Arnidha Y 2015 Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Operasi Hitung Bilangan Cacah e-DuMath Vol. 1 52–63
[27] Rahmania L and Rahmawati A 2016 Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita J. Mat. dan Pendidik. Mat. I 165–74
[28] Syafmen W 2003 Identifikasi Kesalahan Siswa Dalam Menyelesaikan Soal Matematika di SMA (Studi Kasus SMA N 11 Kota Jambi) J. Kreat. Tadulako 17 73–7
[29] Widodo S A, Turmudi and Dahlan J A 2019 An Error Students In Mathematical Problems Solves Based On Cognitive Development Int. J. Sci. Technol. Res. 8 433–9