Profile of elementary school teachers’ ability in analyzing higher order thinking science question

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Abstract. The purpose of this research was to analyze the ability of profile teachers from elementary schools. The subjects were 8 teachers taken from 14 teachers in Elementary School in Philippines and 8 teachers taken from 15 teachers in Elementary School in Central Java, Indonesia. This was a descriptive quantitative research. The instrument used had 15 items with HOT Levels that were comprised of C4 (Analyze) represented in 5 items, C5 (Evaluate) referring to 5 items, and C6 (Create) referring to 5 items. The result showed the level that could be analyzed by the teachers whereby C6 level could be analyzed with the highest percentage of 58.3%, and C4 level could be analyzed with the lowest percentage of 48.6%. Based on the result, it could be concluded that in analyzing HOT questions the Philippine teachers could analyze the questions correctly with the percentage of 81%, and Indonesian teachers could analyze the questions correctly with the percentage of 79.8%. The teachers from both schools were classified in the good category in analyzing the HOT science materials.

1. Introduction
Higher-order thinking skills are the abilities of the educational learning process, especially at the highest three levels in the hierarchy of cognitive processes identified in cognitive Bloom taxonomies of C4 (Analyze), C5 (Evaluate) and also C6 (Create). HOT consists of critical thinking skills and creative thinking skills [1,2] HOT is defined as the ability to apply knowledge, skills and values in making excuses and reflections for problem-solving, decision making, and being innovative as well as able to analyze, evaluate, and create something [2,3]. One of the goals is to improve students’ problem-solving skills so that they are able to overcome difficulties in their learning activities and everyday life [4].

HOT occurs when someone gets new information, holds it, organizes and associates it with knowledge based on his experience related to how he thinks, solves problems and learns [5,6]. Ability to solve problems, make, analyze, evaluate and so on are required to process the information gathered to produce an idea [3,7]. Before students carry out assignments, the teacher can stimulate HOT among students by giving a couple of challenging questions [5]. Teacher’s quality is one of the keys in achieving goals [4]. Science teachers should ideally have the understanding and ability to plan performance assessments in The metacognitive abilities possessed by a teacher are very important related to teacher professional development in order to capably reflect the teachers’ work and support the process of learning [8,9]. In this regard, teachers who convey concepts or ideas systematically in order to improve higher-order thinking skills can monitor the effectiveness and efficiency of learning activities as well as optimize educational goals in certain activities [5,10].

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Improving teachers’ quality can have a positive impact on the quality of education [11]. To understand the information, they are looking for, they must link a set of information with other information and think critically. The ideal teachers must master the material they learn and teach it well [11]. This means that the teachers have the task of packing and presenting the knowledge they have in such a way that applies the right learning model as one of the determinants of students in achieving certain competencies. Therefore, the teachers need to improve their abilities regularly [11] and also maintain the effectiveness when the learning process occurs [12].

2. Method
The method used in this research was a quantitative descriptive survey. In collecting the data, the researchers used test and interview. The subjects of this study were 8 teachers taken from an elementary school in Philippines and 8 teachers taken from an elementary school in Indonesia. The test based analysis HOT (Higher Order Thinking) was utilized, and it consisted of 15 items of circle choice as regards science materials because cognitive style was closely related to students’ learning environment [6]. Pertinent to the three lowest order thinking options, there were (C1, C2, and C3) and further three higher order thinking options involved (C4, C5, and C6) [13,14]. Instrument validity test was conducted using Pearson’s Product Moment correlational test with the following terms: if rstatistic > r table, the item is considered valid, and if rstatistic < rtable, the item is considered invalid and needs to be removed. The instrument of validity test obtained the lowest score of 0.515 and the highest one of 0.892 > rtable, with 16 teachers as respondents alongside rvalue = 0.443, meaning that the instrument of HOT item was valid. Meanwhile, the reliability test obtained by Alpha Cronbach was 0.941 > 0.443 meaning that each of items was reliable to be implemented in the experimental and existing classes. There are C4 (analyzing) level consist of 5 items there are question number 1, 2, 4, 10, 12. The C5 (evaluating) consist 5 items there are question number 5, 7, 8, 13, 14. And the C6 (Create) level consist of 5 items there are question number

3. Results and Discussion
HOT requires justification or explanation [3]. Teachers analyzed their correct and incorrect answers from the questions using HOT level especially in science materials based on the ability of critical thinking [15]. The reachable percentage of correctly answered questions for Philippine teachers was 48.61% at C4 level, 54% at C5 level, and 58.33% at C6 level. The Philippine and Indonesian teachers’ ability to analyze HOT is shown in figure 1. The result of Philippine teachers’ ability indicates that the teachers have difficulties to analyze HOT concept at the C4 level whereby based on the lowest percentage that is determined there are only 48.61% of teachers who can answer correctly (questions number 1, 2, 4, 10, and 12). The highest score here is determined at the C6 level, with a percentage of 58.33% (question number 3, 6, 9, 11 and 15). In addition, the reachable percentage of correctly answered questions for Indonesian teachers is 29.16% at C4 level, 12.5% at C5 level and 75% at C6 level.

![Figure 1. The Philippine and Indonesian teachers’ ability to analyze HOT questions.](image-url)
Meanwhile, the result of Indonesian teachers’ ability indicates that the highest score determined at the C6 level with the teachers’ percentage of 75% can answer correctly the questions number 3, 6, 9, 11 and 15. While, the teachers have difficulties to analyze HOT concept at C5 level as proven by the correctly answered questions with a percentage of only 13% (questions number 5, 7, 8, 13 and 14).

3.1. Analyze in C4 level
The teachers almost could not differentiate the questions categorized at C4 level and C5 level. Based on the result, Philippine teachers had difficulties to analyze the questions at C4 level such as those at number 4, 10, and 12. The ability to analyze questions is needed and can lead the teachers to manage to classify them [16,17]. The answer question in C4 level consist of 3 items there are 4 with the correct answer 7 teachers, question number 10 and 12 with correct answer 4 teachers. Pertinent to the teachers’ answers at C4 level specifically represented by question number 4, 10, and 12, There are 7 teachers who have correctly answered the question number 4, and 4 teachers who have merely been able to correctly answer the question number 10 and 12. A misconception occurs among the answers of the question number 10.

For example, at the C4 level (question number 10), of 8 teachers, there are only 4 teachers who answer the question correctly. In this question, the correct answer is (C4) analyze (Figure 2). The objects are caterpillar and leaves of ornamental plants, and we must analyze the first object that is a caterpillar when the caterpillar is already dead, we think that the population of caterpillar automatically decreases. However, if there are only few caterpillars, they will not change to be a lot of butterflies. It means the number of the butterflies decreases. Based on the analysis process, this question is included in a C4 level. It describes the analysis of a collection in order to discover the main challenges [1,7] (Figure 3).

![Figure 2](image)

**Figure 2.** The example of the reason beyond the teachers’ incorrect answer at C4 level.

Based on the reason above, on the question number 12, what the teachers must know is about analyzing the objects presented in the given table. This question is identified by a table that consists of 8 objects. The teachers must identify each object containing heat conduct properties. First we look at the object inside of the table and we must know the heat conduct properties to analyze the objects before classifying them. Thus, we can conclude that the question is included in C4 based on “analyze” and classified process.

![Figure 3](image)

**Figure 3.** The example of the reason beyond the teachers’ correct answer at C4 level.

3.2. Analyze at C5 level
The teachers’ concept at C5 level is about evaluating the question. In this regard, 54% of Philippine teachers can answer the questions correctly, and there are only 13 % of Indonesian teachers who can answer the questions correctly. This concept consists of 3 questions (5, 7, and 8). Meanwhile, Indonesian teachers also had difficulties when differentiating the questions at the level between
C4 and the C5. The answer question in C5 level consist of 3 items there are 5 with the correct answer 5 teachers, question number 7 and 8 with correct answer 4 teachers.

Before we answer this question we must know two pictures about the electrical circuit. Look at picture A that uses the series circuit and picture B that uses the parallel circuit. We can evaluate the two pictures in order to know which one that is more profitable or which one that is better to use an electrical circuit at home. After we evaluate the two pictures above, we can solve this question (Figure 4). Based on that reason, it means that this question is included in level C5, and it needs to be assessed regarding how to judge the value of materials and methods for their intended purpose as well as to be able to appraise the material against criteria [14] (Figure 5).

![Figure 4](image)

**Figure 4.** The example of the reason beyond the teachers’ incorrect answer at C5 level.

![Figure 5](image)

**Figure 5.** The example of the reason beyond the teachers’ correct answer at C5 level.

The question number 5 talks about food chain. The correct answer is (C5). This question has two pictures with different meanings. Look at the picture A and analyze the kind of lamp, and how the effect for saving electricity is. When getting the reason if the picture is more profitable, we write our reason to answer this question. Thus, we can conclude that the question is included in C5 level because such conclusion can be drawn based on our evaluation from the two pictures and also our reason [14].

3.3. **Analyze at C6 level**

Analyze at C6 level is needed when we get an idea to make something new. The correct answers from questions at C6 level shown in the represent 3 questions whereby they are the questions number 3, 6, and 9. The most correct answer is indicated by question number 3 which is answered by 7 teachers. The answer question in C6 level consist of 3 items there are 3 with the correct answer 7 teachers, question number 6 with correct answer 4 and 9 with correct answer 3 teachers. At the C6 level, Philippine teachers can answer the question correctly with a percentage of 58.33%, meanwhile Indonesian teachers with the highest percentage of 75%. (Question number 3, 6 and 9). We know that C6 is the level of “create”. The “create” level always uses the concept of learning by doing or constructing the new one from the question. For example, in this question, we must create the food webs on the rice field ecosystem and its position in these food webs. Therefore, it can be concluded that we create or construct a creativity to answer this question. Based on the figure 6 actually, students and teacher can put unlike things together in a new way or reorganize the existing things to make something new or solve a problem with multiple solutions and to plan some procedures to accomplish a particular goal. [14,18].

![Figure 6](image)

**Figure 6.** The example of the reason beyond the teachers’ correct answer at C6 level.
In question number 9, many teachers already understand the correct answer. The correct answer is (C6) create. It can be seen at the level of “create” based on the question. This question asks us to draw a large or small circulatory system. Hence, we must construct a sort of mind mapping to begin a structure of the circulatory system in order to capably input some explanations in every step of the circulatory system. Based on the result, the teachers must understand of analyzing the question [7] that will be implemented for their students.

4. Conclusion
Based on the result of the research, it can be concluded that the teachers’ ability to analyze HOT questions is implemented appropriately. One of the significant problems in this research is to analyze the C4 level and C5 level. The researchers are so thankful to Elementary Laboratory School of BSU and the teachers who study in UNS for supporting this research process and improvement.

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