Do the critical thinking skills perform well? A Survey on Pre-service Science Teachers

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Abstract. Critical thinking skills are a pivotal domain for students to have in today’s era. The learning process therefore must be able to train it. In order to train it by the learning process, its very important to be mapped. This study aims to investigate how level of students’ critical thinking skills of preservice science teachers. A survey method was conducted. The Cornel Critical Thinking Skill Test-Level X instruments used to measure the aspects of induction, deduction, observation and credibility, and assumption. The participants of this study were 106 science teacher candidates. The analysis was carried out by grouping students into five levels of critical thinking skills, namely level 1 (very low), level 2 (low), level 3 (sufficient), level 4 (high), and level 5 (very high). The results show that the generally are in the level 2 (low category). For the induction, deduction, observation and credibility aspects are in the level 2 (low category), while the assumption aspects are in the level 1 (very low category). This shows that critical thinking skills need to be trained in students. The learning process carried out must be able to facilitate students to have critical thinking skills.

1. Introduction
Higher order thinking skills (HOTs) are very essential skill to train in the learning process. In higher education learning, critical thinking skills are very important to be trained [1]. According to Shukla [2], the essence of the achievement of the learning process in higher education which is to train HOTs. HOTs are very important training in the learning process, because it’s trained the students be able to encounter challenges or problems in daily life [3-5].

As a part of HOTs, critical thinking are pivotal domain to be mastered by students [5, 6]. Critical thinking is a high-order thinking ability that emphasizes the skills to obtain information, then compares and evaluates that information, and it is able to use this information in order to solve a problem [7]. In critical thinking, a person is required to think objectively and deeply, because critical thinking is goal-oriented, logically reasoned, and target-oriented.

According to Binkley [8], critical thinking skills are part of the 21\textsuperscript{st} century skills. In this 21\textsuperscript{st} century, the learning process should have more emphasis on aspects of HOTs, one of which is critical thinking skills, as the goal. Critical thinking have a guide function that can direct students to provide solutions to a problem. Therefore, through critical thinking skills ability which are part of HOTs, students will be trained to encounter challenges or problems in daily life [4, 5].

Therefore, the science learning process carried out by pre-service science teacher must be able to facilitate students to have critical thinking skills. Through the learning activities carried out pre-service
science teacher can explore their critical thinking power.

Before the educators design learning activities, the most important thing to do is map out how critical thinking skills are achieved by students. Therefore, in this study, it will be mapped how the critical thinking achievement skills owned by pre-service science teacher.

2. Methods

This study intend to obtain an overview critical thinking skills achievement of pre-service science teacher at one of the university in Central Java, Indonesia. The survey method was used in this study, with research respondents as many as 106 pre-service science teacher currently studying in their second year of study.

This study used the Cornel Critical Thinking Test Level X (CCTT-LX) instrument by Ennis. This CCTT-LX can be used at the high school or college level [7]. CCTT-LX is a critical thinking skills instrument which consists of 71 multiple choice items, each consists of three choices, consisting of the induction, deduction, observation and credibility, defining assumptions dimension. Each true score will be given a score of 1, and the wrong score will be given a score of 0. The respondent (in this case pre-service science teacher) takes the entire test in about 50 minutes.

Data analysis was performed by providing an interpretation of the score. Score interpretation is carried out by: (1) interpretation of the overall score to provide an estimate the average achievement of students’ critical thinking skills as well as the achievements of each student; (2) interpretation of critical thinking skills achievement scores for each student; (3) interpretation of the average critical thinking skills achievement score for each dimension. Score interpretation is done by converting the achievement score on a scale of 0-100, then using the conversion score to make an interpretation (using the ideal mean value and ideal standard deviation). Interpretation of critical thinking skills achievement scores can be seen in Table 1.

| Range            | Level | Category   |
|------------------|-------|------------|
| Score ≥ 75,00    | Level 5 | Very High (VH) |
| 58,34 ≤ Score < 75,00 | Level 4 | High (H) |
| 41,67 ≤ Score < 58,34 | Level 3 | Medium (M) |
| 25,00 ≤ Score < 41,67 | Level 2 | Low (L) |
| Score < 25,00    | Level 1 | Very Low (VL) |

3. Results and Discussion

In the science learning process, teachers manage the learning activity for developing the critical thinking skills of their students. Therefore, teachers (in this case are science teachers), must have high critical thinking skills [9]. Further, starting from the process of educating pre-service science teacher, critical thinking skills must be trained so they can be equipped to practice critical thinking skills for their students. Before practicing the critical thinking skills of pre-service science teacher, it’s important to map the students’ critical thinking skills achievements.
Figure 1. Critical Thinking Skills Achievement for Pre-service Science Teacher

The results of data analysis on the critical thinking skills achievement for each student can be seen in Figure 1. Based on Figure 1, the critical thinking skills achievement for pre-service science teacher is dominated at level 2, or in the low category, even as many 9 students can only reach level 1 or in the very low category, while 29 students reached level 3 or enough category. Meanwhile, the highest level can only be achieved at level 4 (high category of 3 students). This finding is in line with the study findings that the critical thinking skills of pre-service science teacher in Turkey, where in general their critical thinking skills were inadequate [7].

Figure 2. Distribution of Student's Critical Thinking Skills Achievement

The distribution of scores obtained by pre-service science teacher can be seen in Figure 2. The critical thinking skills achievement of pre-service science teacher needs special attention to be trained in each learning process. In general, the average score for critical thinking skills of science teacher candidate
students is 36.71 or at level 2 (low category). Based on Figure 2, the highest distribution is at level 2 (low category) and followed by level 3 (medium category). Based on the previous study, the achievement of students' critical thinking skills at the tertiary level is generally at the medium level [10]. Therefore, it is necessary to increase teaching and learning process activities for students that are able to facilitate increased critical thinking skills authorization.

| Aspect of Critical Thinking | Score | Category |
|----------------------------|-------|----------|
| Induction                  | 39.84 | Level 2  |
| Deduction                  | 37.89 | Level 2  |
| Observation and Credibility| 38.81 | Level 2  |
| Defining Assumption        | 23.77 | Level 1  |

In this study, the achievements results of each dimension in critical thinking skills were also obtained. Based on the Table 2, in general, the achievement’s dimension of induction is 39.84, deduction is 37.89, observation and credibility is 38.81. Based on these score, they are in the level 2 category (low level category). Meanwhile, the achievement of the assumption dimension is 23.77, at level 1 (very low category). Therefore, it is important to design purposed learning activities to be effective in practicing every dimension of students' critical thinking skills, because critical thinking skills can be trained through the learning process [11, 12].

The science learning process carried out by pre-service science teacher must be able to facilitate students to have critical thinking skills. Through the learning activities carried out pre-service science teacher can explore their critical thinking power. Critical thinking as pivotal skill that should be mastered by students must be trained in learning process, especially in higher education. In higher education learning, critical thinking skills are very important to be trained [1]. The essence of the achievement of the learning process in higher education which is to train higher order thinking skills [2]. High-order thinking skills are very important training in the learning process, because it’s trained the students be able to encounter challenges or problems in daily life [3-5]. The examples of learning that are able to improve students' critical thinking skills as part of higher order thinking skills are inquiry learning [13-15], learning that integrates research activities [15], inductive approaches [16].

Based on the explanation of this study results, the critical thinking skills achievement of pre-service science teacher has not been well mastered so that it needs to be trained. Currently, critical thinking skills are one of the important skills for students in the 21st century [8], in order to equip students to be able to encounter challenges or problems in daily life [4, 5].

4. Conclusion
Based on the research, the critical thinking skills of pre-service science teacher have not been well mastered. In general, the achievement of critical thinking skills is at level 2 or in the low category. Based on this, it is necessary to practice critical thinking skills for pre-service science teacher. The training process can be done by developing learning activities that are able to practice critical thinking skills in each of its dimensions so that they can be more effective and efficient.

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