Analysis of critical thinking skill profile on the concept of simple harmonic motion using two tier instrument test

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Abstract. The purpose of this study was to analyze critical thinking skills profile of senior high school learners, especially in eleventh grade. This study used qualitative descriptive study to analyze critical thinking skills profile. The subject of this study were eleventh grade student of science classes in Public Senior High School no 4 Surakarta with 87 students whose registered as student in the 2018/2019 school year. Sampling in this study used random sampling technique. The instrument test used in this study was two tier test. The instrument use indicators critical thinking skills developed by Ennis with 5 indicators and 7 sub-indicator. Instrument test consists two stages, the first stage was multiple-choice questions and the second stage was an open-ended free response question which was the reason for the answer of the student to the question at the first stage. The result of this study showed that critical thinking skill were still low. In every indicator critical thinking skill were 42% for basic clarification, 29% for decision or basic support, 27% for inference, 25% advanced clarification, 24% strategy and tactic. Critical thinking skills were low because learning was still centered on the teacher.

1. Introduction
Critical thinking skills are needed to face challenges in the globalization era. In this era the development of information, knowledge and innovation is very rapid. In addition, in the 21st century must have several competencies including life skills and career, learning skill and innovation skill such as (collaborative work, effective at communicating, critical thinking, and creative work), skills or literacy of information, literacy of media, and informations literacy and Communication Technology[1].

In the 21st century, one of the skills must-have for students is critical thinking skills, so critical thinking is one of the skills that must be taught in school [2]. In general learning by instilling critical thinking skills is equally significant for high school learners [3]. Learning by mastering critical thinking skills is to teach learners how to use concepts, principles and procedures appropriately, so that students give a critical assessment of a problem [4]. In addition, critical thinking skills have important implications for channelling knowledge and problem solving in real events [5]. Higher-order thinking skills have several parts, one of which is critical thinking skills[6-7]. Critical thinking has several components such as the skill of analyzing arguments, making conclusions with inductive
and deductive ways, evaluating, and making decisions or solving problems [8]. These components can be further divided into two main components of critical thinking skills, namely the cognitive ability of critical thinking and the disposition of critical thinking [9].

Critical thinking skills have been explained by experts. Some notions of critical thinking skills are the ability to distinguish between relevant and irrelevant, determine the credibility of a source, evaluate existing evidence, and distinguish facts and opinions [10]. In addition, critical thinking skills can also be interpreted as a metacognitive process used to infer an argument or problem solving [11].

2. Methods

The method used in this research is qualitative description. The method is used to determine students critical thinking skills in simple harmonic motion material. The research subjects were 87 students in class XI in Surakarta Public High School 4 in the 2018/2019 school year. Sample selection by random sampling.

The instrument used in the research is an instrument developed by researchers who have been validated by material experts and evaluation experts. The instrument is a two tier test instrument or instrument with two stages. The first stage is a multiple-choice question and the second stage is an open-ended question which was the reason for the answer of the student to the question at the first stage. There are 21 items of question instruments using critical thinking skills indicators developed by Ennis. The question indicator is shown in table 1

| Indicator                          | Sub indicator                          | Question item |
|------------------------------------|----------------------------------------|---------------|
| Basic clarification                | Analyze arguments                      | 1,2,3         |
|                                    | Focus on the question                  | 4,5           |
|                                    | Identify facts and opinions            | 6,7,8         |
| Initial decision or initial support| Assessing source                      | 9,10,11       |
|                                    | credibility                            |               |
| Inference                          | Draw a conclusion                     | 12,13,14,15   |
| Advanced clarification             | Assess definitions                    | 16,17,18      |
| Strategies and tactic              | Make a decision or action              | 19,20,21      |

Student answers are analyzed using answer keys and rubric ratings that have been validated by experts. After analysis and scoring, the next step is to categorize critical thinking skills possessed by students into very good, good, moderate, low, very low categories [12-13]

| Score | Critical thinking skill category |
|-------|----------------------------------|
| 81-100| Very good                        |
| 61-80 | good                             |
| 41-60 | Moderate                         |
| 21-40 | Low                              |
| 0-20  | Very low                         |
3. Results and Discussion

3.1 Result
Critical thinking skills in simple harmonic motion material that is owned by class XI students at public senior high school 4 Surakarta shown on Table 3. Students who were tested previously had already learned simple harmonic motion material. The following are the average critical thinking skills possessed by students.

Table 3. Students’ Average Critical Thinking Skills

| Indicator                    | Average (%) |
|------------------------------|-------------|
| Basic clarification          | 49          |
| Initial decision or initial support | 29          |
| Inference                    | 27          |
| Advanced clarification       | 25          |
| Strategies and tactic        | 24          |

Based on Table 3, it shows that almost all students’ critical thinking skills for each indicator are in the low category. Only basic clarification shows the moderate category. The highest average student critical skills with 49% on basic clarification indicators and the lowest average with 24% in indicators strategies and tactic.

The percentage of students’ answer to each question is shown in Figure 1. The highest average student answer on item number 4 with 70% more students answering correctly. However, there are still a lot of students’ average answers below 30%, about 13 items from 31 questions. This shows that the results are still relatively low. While the lowest average student answer is item number 20 which is the concept of the relationship of circular motion with simple harmonic motion and in this section of the statistical strategies and tactic.

![Figure 1. Percentage of average student answers](image)

3.2 Discussion
Critical thinking skills possessed by students can be developed with the learning process assuming that almost all students can reach critical thinking and students' critical thinking skills continue to evolve [14]. There are several strategies, models and learning methods that can be applied to build and improve critical thinking skills. Some of them are learning by using models and methods of Problem Based Learning. Problem Based Learning can increase critical thinking skills [15]. Cooperative
learning, the reciprocal teaching model can also increase critical thinking skills [16]. The learning approach with Contextual Teaching and Learning (CTL) can also improve problem solving skills and critical thinking skills [17]. Therefore, the selection of methods, models and learning strategies can influence the critical thinking skills of students.

Efforts to improve the critical thinking skills of students must be assisted with instruments that can measure critical thinking skills. Critical thinking skills assessment instruments that are applied to appropriate learning models and methods can improve critical thinking skills [18]. The instrument used must also be valid and reliable. Measuring student skills is very helpful for the teacher to know the progress of students every time [13, 19].

4. Conclusion

From the research it can be concluded that students still have critical thinking skills in the low category and only one indicator with a moderate category, namely the basic clarification indicator. Students' critical thinking skills can be improved by applying appropriate strategies, models and learning methods.

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