A Critical Thinking Skill Profile of Science Education Undergraduate Student in Basic Physics

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Abstract. An undergraduate student should have ability to make the right decision based on data analysis and information able to provide instructions in choosing various alternative solutions independently and in groups. This is an important point in the Indonesian National Qualification Framework at the undergraduate level. One of the skills that must be possessed by students who are part of 21st century skills is critical thinking skills. The aim of this research is to analyze the critical thinking skills profile of science education undergraduate students in basic physics. Subject of this research were undergraduate students with sample of 109 undergraduate students determined by purposive sampling. The instruments have fulfilled the validity requirements ($r_a = 0.26$) and reliability ($\alpha = 0.99$). Result of this research that the profile of science education undergraduate students is very low level. The students’ critical thinking skills need to be improved based on that level.

1. Introduction

Basic physics is the basic science that must be mastered by science education undergraduate student. In basic physics there are various sciences related to science, technology, pedagogy and knowledge. Lecturers often find it difficult to convey basic physics materials to be easily accepted by student. The basic physics lecture has more effort in the class everyday: they must achieve that their undergraduate students extract the major possible learning results in the class. Therefore, the lecture must motivate the students in order that they learn and take part in class [1]. Many undergraduate students are not interested in studying and understanding basic physics. Based on the opinion of this student is only a requirement to study basic physics and the younger generation who like it [2]. But lecturers strive to train and improve a variety of 21st century skills for undergraduate student, one of which is critical thinking skills. Critical thinking skills involve the ability to explain important questions, give relevant information, reach well-reasoned conclusions, make accurate decisions assessing the credibility of sources, identify causes that affect relationships and effectively communicate with others in search of solutions [3].

The facts show that indicators of critical thinking skills are almost very difficult to find in classroom learning. Indicators of critical thinking skills have not been developed as competencies that must be honed among students. It is rare to find students proactively addressing problems in learning. Similarly, very few students dare to answer the problems posed. As a result, students almost never offer solutions to the problems found. This can be used as an indicator that the critical analytical power of students is still low. Some students are still trapped in memorization and mere memory. This causes the information received by students to be very easily forgotten and disappeared. As prospective teachers, students need to do activities that hone critical thinking skills. The thinking of prospective teachers about critical
thinking does not change and less noticeable differences over time. Teacher or lecturer can make decisions with expression references and answer the questions [4]. This is certainly not in accordance with the objectives in the National Qualification Framework

Critical thinking is also known as a metacognitive process, which includes a number of sub-skills i.e. analysing, evaluating, and concluding that are used to improve the logic of inferring the opportunity of creation toward an argument or solution. The low critical thinking skills of learners can be seen from the lack of participation of learners in asking, arguing, commenting, and explaining. Critical thinking skills are concerned with deeper and higher thinking as the process of considering a topic or problem from a variety of perspectives [5-7].

Undergraduate students need to be trained and developed their critical thinking skills, which are analysis, explanation, evaluation, interpretation, inference and self-regulation ability, now we called them critical thinking skill’s indicators [8]. But, the critical thinking skills’ indicators to be observed in this research are analysis, evaluation, interpretation, and inference.

In order to analyse critical thinking skills for science education undergraduate students, so there is a need for research that focuses on looking at the profile of science education undergraduate students’ especially in basic physics and use this result as empirical data to developing critical thinking skill. Furthermore, the next study is needed as an alternative solution of critical thinking that is very low level.

2. Method
2.1 Background
This pre-experiment research is to analyse the profile of science education undergraduate students’ critical thinking skills on basic physics.

2.2 Sample
The sample is science education undergraduate students consist of 109 students of first, second, third and fourth year. Purposive sampling is used to determine of the sample in this research.

2.3 Procedure
This research procedure that researcher to be done: (1) studying the literature that relate with critical thinking skills; (2) finding indicators; (3) finding critical thinking skills instrument to determine the profile of science education undergraduate students on basic physics (4) analysing validity and reliability instrument; (5) Measuring 109 students using the critical thinking instrument to determine the profile of science education undergraduate students critical thinking skills on basic physics; (6) analysing and making conclusions based on the results of the critical thinking skills instrument.

2.4 Instruments of this research
Using the critical thinking instrument to determine the profile of science education undergraduate students critical thinking skills on basic physics that developed by Jatmiko et al. [9]. This instrument consists of four indicators: analysis, evaluation, interpretation, and inference. This instrument has been declared valid and reliable. Validation results of critical thinking instrument in Table 1.

| Components                  | The Validity of Critical Thinking Skills Instruments | Content Validity |
|-----------------------------|------------------------------------------------------|------------------|
|                             | Construct Validity                                   |                  |
|                             | Cohen's Kappa R rα V α R                             |                 |
| Critical Thinking Skills Test | 1.00 Reliable 0.26 Valid 0.99 Reliable                |                 |

Conclusion: The critical thinking skills instrument that has been developed is valid. It can take as an instrument to measure determine critical thinking skill of science education undergraduate students on basic physics
Notes: $r_a$ = Single measure interrater coefficient correlation; $\alpha$ = Cronbach’s alpha; $R$ = Reliability; $V$ = Validity

The instrument of critical thinking skill test to determine the profile of science education undergraduate students critical thinking skills on basic physics by statistic analyse with Cronbach’s alpha. This instrument valid ($r_a = 0.26$) and reliable ($\alpha = 0.99$).

2.5 Data Analysis

The profile of science education undergraduate student’s critical thinking skill in basic physics. Qualitative descriptive is used to analysed the data. The results will be used to obtain the profile of science education undergraduate’s critical thinking skill, especially on basic physics. After that, this result will be used to recommendations in basic physics learning based on critical thinking skill.

For the results of students answers in completing written tests in order to get a profile of undergraduate students critical thinking skills, they are categorized according to the highest scoring criteria for each criterion. The methods used in completing the study are written in this section.

3. Results and Discussion

The critical thinking skill instrument was valid and reliable based on test of validity, then it done by 109 undergraduate students whose took basic physics subject. The criteria of critical thinking skill based on Table 2 [10].

| Interval          | Criteria       |
|-------------------|----------------|
| $81.25 < x \leq 100$ | Very High     |
| $71.5 < x \leq 81.25$ | High          |
| $62.5 < x \leq 71.5$ | Medium        |
| $43.75 < x \leq 62.5$ | Low           |
| $0 < x \leq 43.75$   | Very Low      |

The result of analysis undergraduate student critical thinking skill in basic physics that presented in Table 3.

| Student Initial | Criteria | Value | Group I | Group II | Group III | Group IV |
|-----------------|----------|-------|---------|----------|-----------|----------|
| U1              | Low      | 55    | 50      | Very Low | 10        | Very Low |
| U2              | Very Low | 35    | 48      | Low      | 35        | Very Low |
| U3              | Very Low | 40    | 30      | Very Low | 28        | Very Low |
| U4              | Very Low | 43    | 31      | Very Low | 31        | Low      |
| U5              | Very Low | 40    | 47      | Low      | 37        | Very Low |
| U6              | Very Low | 35    | 49      | Low      | 26        | Very Low |
| U7              | Very Low | 32    | 36      | Very Low | 28        | Very Low |
| U8              | Very Low | 28    | 31      | Very Low | 28        | Very Low |
| U9              | Very Low | 38    | 29      | Very Low | 27        | Very Low |
| U10             | Very Low | 40    | 45      | Low      | 26        | Very Low |
| U11             | Very Low | 37    | 38      | Very Low | 26        | Very Low |
| U12             | Very Low | 33    | 29      | Very Low | 27        | Very Low |
| U13             | Very Low | 38    | 34      | Very Low | 40        | Very Low |
| U14             | Low      | 51    | 39      | Very Low | 43        | Very Low |
| U15             | Low      | 45    | 32      | Very Low | 28        | Very Low |
Student Initial | Group I Value | Criteria | Group II Value | Criteria | Group III Value | Criteria | Group IV Value | Criteria
---|---|---|---|---|---|---|---|---
U16 | 33 | Very Low | 34 | Very Low | 36 | Very Low | 35 | Very Low
U17 | 33 | Very Low | 57 | Low | 41 | Very Low | 32 | Very Low
U18 | 32 | Very Low | 36 | Very Low | 34 | Very Low | 32 | Very Low
U19 | 39 | Very Low | 41 | Very Low | 8 | Very Low | 32 | Very Low
U20 | 44 | Low | 48 | Low | 37 | Very Low | 32 | Very Low
U21 | 39 | Very Low | 27 | Very Low | 47 | Low | 32 | Very Low
U22 | 44 | Low | 44 | Low | 47 | Low | 32 | Very Low
U23 | 36 | Very Low | 34 | Very Low | 24 | Very Low | 32 | Very Low
U24 | 43 | Very Low | 22 | Very Low | 39 | Very Low | 32 | Very Low
U25 | 36 | Very Low | 28 | Very Low | 41 | Very Low | 32 | Very Low
U26 | 43 | Very Low | 35 | Very Low | 37 | Very Low | 32 | Very Low
U27 | 34 | Very Low | 46 | Low | 46 | Low | 32 | Very Low
U28 | 36 | Very Low | 28 | Very Low | 38 | Very Low | 32 | Very Low
U29 | 34 | Very Low | 28 | Very Low | 31 | Very Low | 32 | Very Low
U30 | 35 | Very Low | 42 | Very Low | 42 | Very Low | 32 | Very Low
U31 | 23 | Very Low | 33 | Very Low | 32 | Very Low | 32 | Very Low
Average | 38 | Very Low | 37 | Very Low | 34 | Very Low | 31 | Very Low

Table 2 shows test outcome of critical thinking skill. In all classes, critical thinking skill of science education undergraduate student in basic physics subject is in the very low level generally. As many as 109 undergraduate student’s score is under 62.5. It also shows that undergraduate student not complete in all indicators. In group I and group II which are first year science education undergraduate students show only 13 with low level and 49 in very low level. In group III, which are second year science education undergraduate students have just 4 in low level, and 26 in very low level. Last in group IV, which are third and fourth year science education undergraduate students just 1 in low level, almost them in very low level. This result was surprised. Because the students are still unknown the test of critical thinking skills in basic physics.

This research used first, second, third and fourth grade undergraduate students. The critical thinking skills in each grade show with Figure 1.

![Figure 1](image_url)
Figure 1 shows criteria of critical thinking skill of undergraduate students in each year. Based on graph, generally undergraduate students on very low level all of year. Specifically, 92% first year, 87% second year and 94% third and fourth year in very low level. Just 8% first year, 13% second year and 6% third and fourth year in low level. There are no one in medium, high and very high level.

Instrument of critical thinking skill consist of four indicators: analysis, evaluation, interpretation and inference. Analysis is ability to identify relationships intended for questions, statements, concepts, description or other representation intended to express judgment, information or opinion. Evaluation is ability to review the credibility of answer the questions or other representations in the form of reports or description of perceptions, experiences, situations, judgment, or opinion, and interpreting.

Logical of the relationship or representation other means. Interpretation is ability to understand expressing or interpreting the meaning of some experiences, events, data, or situations. Inference is the ability to identify and obtain elements necessary to logically in conclusion, making assumptions and hypotheses, consider relevant information and infer the consequences of data and questions other [11]. Critical thinking skill is one of 21th century skills of undergraduate students should have for succeed in today's world. Undergraduate students need some skills such as creativity, critical thinking, innovation, ability of problem solving, good communication and also collaboration [12-16]

Figure 2. Graph of achieving critical thinking skill indicators

Figure 2 shows achieving critical thinking skill indicators. Four indicators of critical thinking skill, analysis with 32% its mean low, evaluation with 21% means low, interpretation with 44% means low and inference with 43% means low. All indicators in low level.

Figure 3 shows achieving critical thinking skill indicators of undergraduate students in each year. Based on that graph, the first-year undergraduate students have lowest level in each indicator. But, the second, third and fourth-year undergraduate students almost at same point. Generally, all of the undergraduate students in low level.

Increasing of undergraduate students' critical thinking skills is closely related to the understanding of the student's physics concepts. Highlights the importance of critical skills in the framework of educational concepts [17]. In his research mentioned that critical thinking skills and high-level thinking skills must develop among students in the educational process. Furthermore, to practice the critical thinking skills one of them is by angling students to argue. Reveals the influence of scientific arguments on the development of student critical thinking. In his research it is known that the critical thinking skills of students improve significantly by using scientific argument strategies [18]. This is in line with four indicators of critical thinking skills providing basic clarification as well as advanced clarification.
Critical thinking skills along with scientific argumentation contribute to understanding concepts in different spell models [19].

An essential skill that must have of undergraduate student is critical thinking skill, it is from some studies result about science teacher [20-23] which showed that assessment and learning about critical thinking skill are indispensable and driven by the needs of students at the college level and work environment.

Based on table and figures above the result of this research showed that undergraduate students are very difficult in applying critical thinking skill in basic physics subject, especially in solving the test which are need deeply of analysis, evaluation, interpretation and inference. So, it is needed to find an alternative solution to solve this problem. Learning with experience could be try to this problem.

Nevertheless, the student's critical thinking skills cannot be acquired in a short period of time. An ongoing process is needed to practice critical thinking skills in students. In line with this, research by Grussendorf and Rogol [24] reflect on critical thinking skills at a time. In the results of his reflection obtained that the initial jump in critical thinking skills after training for one semester, but at the end of the study it takes a longer time to score above average.

Critical thinking skills can be achieved one of them by practicum-based learning with workbook laboratory [25]. One of way to improve student’s critical thinking skills with clear and simple instruction was by practicum-based learning [26]. In research of Balta N [27] stated that the results of the survey of instructional design science laboratory needs obtained a very high average value in the sense that laboratory instruction can improve the learning process of science in laboratory settings. In some scopes of education, science practicum learning receives less attention, as expressed in research laboratory instruction as part of the reform of science does not fully have the support of the relevant parties [28].

In line with this, it is necessary to develop learning tools that can accommodate the needs of students' knowledge and skills. Learning tools based on practicum activities with simple and easy to understand patterns. Learning tools developed with Inquiry Based Laboratory Instruction are expected to be a means for students to improve critical thinking skills [29]. Inquiry Based Laboratory Instruction have six syntax: (1) Present contextual issues, (2) Planning, (3) Implementation, (4) Analyse and interpretation, (5) Communicating/Presenting, and (6) Make follow up [30]. This syntax of Inquiry Based Laboratory Instruction estimated improved critical thinking skill of science education undergraduate students. The Inquiry Based Laboratory Instruction learning model is believed to be the most relevant teaching model.

**Figure 3.** Graph of achieving critical thinking skill indicators of undergraduate students in each year.
for promoting scientific concepts and scientific processes as well as developing research skills, including asking research questions, formulating hypotheses, and compiling tests of hypotheses [31]

4. Conclusion
From this result, critical thinking skill profile of science education undergraduate students in basic physics is still at a very low level generally. The achieving level of indicators competence also at low. Impact of this research can be used as empirical evidence that critical thinking skill of science education undergraduate students in basic physics still needs to be improved. The next research needs as an alternative solution to solve the very low level of critical thinking skills of science education undergraduate students in basic physics.

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