Profile of Students' Creative Thinking Skills on Global Warming Material: Gender Perspective in Physics Learning

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Abstract. Students need creative thinking skills, critical thinking, collaborative, and communicative in the 21st century in learning physics. In predicting further research, it is necessary to analyze the initial ability of students' creative thinking skills. This study aims to analyze the profile of physics learning on the students' creative thinking skill of high school students' on global warming material and analyze the differences in students' creative thinking abilities based on gender. Research method uses 100 samples of class eleventh grade in senior high school students'. Profiles of creative thinking skills of senior high school students' on global warming were analyzed quantitatively descriptively. The results showed that the physics learning profile of students' creative thinking skills on global warming material was relatively low, and there was a significant difference between the results of male and female students' creative thinking skills. The results of this study can be used as empirical evidence that the creative thinking skills of high school students' physics learning on global warming material still need to be improved. Further research is needed to overcome the low creative thinking skills of high school students'.

1. Introduction
In the process of learning physics, both teachers and students are required to think creatively. Creative thinking is one of the skills in the 21st century, especially physics learning. Skills that can be involved in learning physics in the 21st century such as 4C are creative thinking skills, critical thinking, collaboration, and communication [1,2]. CTS is creative thinking Skill. One of the outputs of CTS is shown by creating new ideas during the learning process, and the teacher creates an interactive learning atmosphere. To make it easier for students to convey ideas, fun learning conditions are needed.

In physics learning, CTS is needed. CTS is a skill to solve problems by creating unique, different, and logical ideas. Indicators of creative thinking skills are fluent thinking, flexible thinking, elaboration, and originality [3-5]. Students who can think creatively are shown to dare to give arguments of different types from physical phenomena, produce many different views that are not similar, can create ideas, can find relationships between variables of physical quantities, and tend to have high imagination power while applying physics concepts [6,7]. CTS is measured by three levels, namely high, medium, and low. The main principle in CTS is included in the realm of higher-order thinking skills so that with these abilities students will be trained to compete in the global world.

From the before CTS explanation, students who are creative in understanding problems are a big hope for teachers. Students who are creative in offering solutions will be trained in higher-order thinking, but students' CTS in solving problems is still relatively low. This is shown by the global index data in 2010. The data states that the CTS of students in Indonesia is ranked 81 out of 82 countries in the world [8-10]. From the data, it is stated that students have difficulty in implementing ideas. Difficulty in implementing ideas because students do not understand the material being studied, including
understanding global warming material. So, the data contradicts the expectations of skills in the 21st century. Where teachers and students must have good CTS. In creating change, high integrity is needed in physics education, so students need to train their thinking skills [11-13]. In order to analyze appropriate learning in training students' physics CTS level, it is necessary to analyze the physics CTS profile, one of which is on global warming material.

Through the phenomenon of low creativity of students in physics, so necessary to analyze the CTS of students specifically in the subject of global warming. Observing the importance of CTS in learning physics for students, this study aims to look at the profile of students' CTS levels, especially the material on global warming. The results of this study are expected to be empirical evidence for education in Indonesia to continue to innovate in improving students' creative ideas.

2. Method

2.1 General background

The design of this study was pre-experimental. Main objective of the study was to analyze students' thinking skills on the subject of global warming in physics learning. The second objective is to analyze students' CTS each gender in physics learning.

2.2 Sample of research

The subjects of this study were 100 students of class XI at senior high school in Indonesia. Sampling with purposive sampling technique.

2.3 Procedure of research

The research procedure consists of 1) Researchers conducting literature studies related to creative thinking skills 2) Developing instruments for CTS related to global warming material in physics learning 3) Providing instruments developed by three experts to be validated 4) Research conducting revisions related to input and suggestions from validators 5) Researchers measure creative thinking instruments in 100 students of class XI 6) researchers process data related to creative thinking instruments 7) researchers analyze and conclude research results based on the level of CTS in physics learning.

2.4 Instruments

The use of creative thinking instruments in research is to determine the profile of students' CTS level. The research instrument is 7 questions about global warming material that have been integrated with CTS. In physics learning, CTS have 4 indicators, namely fluency, flexibility, originality, and elaboration. The CTS instrument was evaluated by 3 experts based on 5 statements. The first statement is related to the suitability of the questions with the material indicators of global warming, the second statement, the questions given are by the skills being trained, third, the questions made have the right proportions with the material being taught, the four questions use good and correct language, the five questions are made not to cause multiple interpretations. This instrument has been said to be valid and reliable. The results of the validation of the CTS instrument in Table 1.

| Statement to- | V1 | V2 | V3 | Modus | Validity | Cronbach’s Alpha (α) | Reliability |
|---------------|----|----|----|-------|----------|----------------------|-------------|
| 1             | 4.00 | 4.00 | 3.00 | 4.00 | Valid | 0.63 | Reliable |
| 2             | 4.00 | 3.00 | 3.00 | 3.00 | Valid | Reliability |
| 3             | 4.00 | 4.00 | 4.00 | 4.00 | Valid | Reliability |
| 4             | 3.00 | 3.00 | 4.00 | 3.00 | Valid | Reliability |
| 5             | 4.00 | 3.00 | 4.00 | 4.00 | Valid | Reliability |
| Average       | 3.80 | 3.40 | 3.60 | 3.60 | Valid | 0.63 | Reliable |

Conclusion: Instruments of CTS that can be further processed in research
The instrument about CTS to determine the level of creative thinking of class XI high school students on global warming material was declared valid and reliable. Improvements and suggestions by the physicist validator regarding the instrument are reducing questions from 10 questions to 7 essay questions, improving grammar, and writing correctly according to Bloom's taxonomy. From the calculation results obtained the percentage of validity of 90%.

2.5 Data Analysis
The profile CTS of class XI high school students on global warming material in physics learning was analyzed quantitatively descriptively. The results of the study were to determine the initial profile of student's CTS on global warming material. The level of student's CTS is categorized as high if the score is > 8.00; medium if 6.10<s<7.90; and low if s<6.00. While the percentage of students' CTS is said to be high if > 80%. Analyze the differences in the results of students' CTS between men and women were analyzed using the ANOVA test. In the next stage, it will be used as a tool in the application of physics learning related to global warming material.

3. Results and Discussion
3.1 Level of students' CTS
After test instrument was declared valid by 3 experts physics, then instrument was tested initially on 100 high school class XI students who taught physics. The test results of students' CTS are presented in Table 2.

| Personal Student | Group 1 Value | Criteria | Group 2 Value | Criteria | Group 3 Value | Criteria |
|------------------|---------------|----------|---------------|----------|---------------|----------|
| P1               | 4.60          | Low      | 3.70          | Low      | 2.30          | Low      |
| P2               | 4.50          | Low      | 4.00          | Low      | 2.60          | Low      |
| P3               | 4.20          | Low      | 5.10          | Low      | 4.00          | Low      |
| P4               | 6.40          | Medium   | 5.50          | Low      | 3.10          | Low      |
| P5               | 5.50          | Low      | 2.80          | Low      | 3.50          | Low      |
| P6               | 5.60          | Low      | 3.80          | Low      | 3.70          | Low      |
| P7               | 6.40          | Medium   | 4.40          | Low      | 4.50          | Low      |
| P8               | 4.50          | Low      | 5.50          | Low      | 4.10          | Low      |
| P9               | 3.80          | Low      | 4.30          | Low      | 4.40          | Low      |
| P10              | 5.80          | Low      | 2.60          | Low      | 4.60          | Low      |
| P11              | 3.50          | Low      | 5.00          | Low      | 4.80          | Low      |
| P12              | 6.30          | Medium   | 5.40          | Low      | 4.80          | Low      |
| P13              | 4.10          | Low      | 2.40          | Low      | 5.00          | Low      |
| P14              | 3.60          | Low      | 4.80          | Low      | 2.60          | Low      |
| P15              | 5.40          | Low      | 5.40          | Low      | 7.60          | Medium   |
| P16              | 5.50          | Low      | 5.30          | Low      | 4.40          | Low      |
| P17              | 3.40          | Low      | 6.30          | Medium   | 6.40          | Medium   |
| P18              | 2.80          | Low      | 2.10          | Low      | 6.00          | Low      |
| P19              | 3.00          | Low      | 3.80          | Low      | 5.20          | Low      |
| P20              | 4.30          | Low      | 3.60          | Low      | 6.00          | Low      |
| P21              | 6.10          | Medium   | 5.30          | Low      | 5.00          | Low      |
| P22              | 610           | Medium   | 6.40          | Medium   | 2.60          | Low      |
| P23              | 3.00          | Low      | 4.00          | Low      | 2.60          | Low      |
Table 2 shows that students’ CTS on global warming material in each group are stated low. A total of 84 students have low-level creative thinking skills as indicated by a score of <6.00, while the other 16 students have medium-level creative thinking skills with 6.10<score r<7.90. Most students are not able to achieve high-level skills for all indicators. These results indicate that the level of CTS in physics learning of class XI high school students is still relatively low.

3.2 Percentage CTS of each indicator

Overall indicators of students’ CTS on global warming material are in a low category. The indicators physics learning of students' CTS consist of fluency, flexibility, originality, and elaboration [14,15]. Percentage results of the initial test of students’ CTS are presented in Figure 1. While each percentage of the initial results of student's CTS on global warming material is presented in Figure 2.

![Figure 1. Percentage of trial results](image)

Based on Figure 1 shows that the level of CTS of students at the low level is 78% and the medium is 22%. This shows that the overall CTS of students are in a low category. Furthermore, the percentage graph of each student indicator is presented in Figure 2.
Figure 2 shows that the percentage of CTS indicator in physics learning gets the largest percentage on the fluency indicator, then the lowest CTS indicator on originality. Fluency indicators have an average of 67%, 53% flexibility, 46% elaboration, and 37% originality. In this case, it shows that of the four indicators, there are 3 indicators that are still low. So it shows that the profile of student's CTS at physics learning global warming material is still low. The lack of reading and students’ material physics in everyday life is the cause of the low creativity of students [16]. In this case, innovative applications are needed to increase students' CTS [16], especially global warming material.

3.3 Results of differences in students’ CTS on gender and groups

After looking at the profile of students’ CTS as a whole and based on indicators, then the differences in students’ CTS based on gender were analyzed. The results of the differences in gender are presented in Table 3.

| Variabel Independent and Dimentions | df | Mean Square | F     | Sig. (2-tailed) |
|-----------------------------------|----|-------------|-------|----------------|
| Male*female                       | 1  | 53.730      | 50.995| .000*          |

*significant at p < .05

Based on Table 3 shows that the results of sig 0.000. This shows that there is a significant difference between the results of the initial CTS of male and female students in physics learning. The result of this significance is that women have higher creativity than men in physics learning. With a female average of 5.236 and a male of 3.603. Furthermore, the results of the differences in CTS in each group are presented in Table 4.

| Variabel Independent and Dimentions (I) | Mean Difference (I-J) | Sig. |
|----------------------------------------|-----------------------|------|
| Group 1                                | Group 2               | .09394| .951 |
| Group 1                                | Group 3               | .34492| .506 |
| Group 2                                | Group 1               | .09394| .951 |
| Group 2                                | Group 3               | .25098| .696 |
| Group 3                                | Group 1               | .34492| .506 |
Based on Table 4, shows that there is no significant difference in the results of students' CTS between group 1, group 2, and group 3. This is indicated by a significant value $> 0.05$. Each group got a low and commensurate score because students had not received previous global warming lessons. In this case, it shows that this research can be continued by applying innovative learning and building students' creativity.

Students' fluency thinking skills at physics learning global warming material get a larger percentage than other indicators. In the indicator of fluency thinking students get many similar ideas. Students can respond smoothly to a problem obtained from everyday life. Problems with fluency indicators direct students to stimulate ideas in answering questions [17,18]. So that the fluency indicator gets a medium percentage. Then at physics learning material global warming with indicators of flexibility, elaboration, and originality directs students to analyze the mechanism of the greenhouse effect. The questions of the three indicators obtained a low percentage. In the research, students have difficulty in giving different arguments that are not similar [19]. So that students can give many different and dissimilar arguments, it is necessary to read a lot of literacy on material topics [20]. Furthermore, students have not completed the questions with indicators of elaboration and originality. Students cannot give original ideas in answering questions. Students cannot provide arguments for the entire contents of the table and do not give a unique view in responding to the phenomenon of the greenhouse effect. This is because students are not trained in honing creative thinking skills. They can provide unique arguments if they are accustomed to sharpening their original skills by generating new ideas [21]. All of these indicators give the result that students' CTS in physics learning are very low. In line with [22] states that students have high creativity when trained with project-based physics learning.

Solutions to improve students' CTS by giving different learning physics. Learning physics that actively involves students will create an independent learning atmosphere [23,24]. Student activity during the learning physics process can be created with the help of problem-based learning [25-27]. Learning physics by giving a variety of cases can make students have many arguments and ideas [28]. Then learning based on projects and problems will make students create original ideas [29-31]. Learning strategies by making students the center of learning will facilitate mastery of concepts physics. In line with [32,33] states that problem-based learning strategies are able to train students' creativity. Problem-based learning physics will make it easier for students to create ideas that are unusual and not thought of by others. In this study, the female gender had higher CTS than the male gender. This is in line with [34,35] mentioning that women have higher creativity. Besides gender differences affect students' creativity and other factors such as the management of affective learning attitudes also affect students' creativity [36]. Through the indications of the results of this study, it can be used as further research in comparing the results of student creativity based on gender in a wider and different respondent. Analytical thinking is able to train students' creativity [37-39].

4. Conclusion
In the case of this study, the profile of student's creative thinking skills (CTS) at physics learning global warming material is low, and there is a significant difference between the results of male and female students' creative thinking skills (CTS). The results of this study can be used as empirical evidence that the CTS of grade XI students in the subject of global warming in physics learning still need to be improved. Further research is needed to be able to overcome the low CTS of students in high school.

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