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## The Profile of Junior High School Students' Creative Thinking Skills about Alternative Energy in Science Learning

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### Abstract

The most crucial role of creative thinking skills for students is encouraged by way of thinking to prove the truth of an assessment formulation. Teachers need to know students' creative thinking skill profile and fulfill each indicator level to generate focused ideal learning to improve creative thinking skills. This research was conducted to explore junior high school students' creative thinking skill profile in science learning about alternative energy. This research is a quantitative descriptive essay test method. Respondents are 110 7th-grade junior high school students in Jember, East Java, Indonesia. The results showed that the creative thinking skills of junior high school students is low (44,98%). Students' creative thinking skill still need to be developed. Some students find it challenging to design a unique creative work on alternative energy. We suggest that creative thinking skills need to improve by developing learning methods, models, strategies, approaches, media, context, and interaction in the discussion process.

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## INTRODUCTION

The essential components of 21st-century skills are IMT (Information, Media, and Technological), learning and innovation, and life and career skills. The 21st century led teachers to focus on student's skills development. However, one of the most accessible places to begin is addressing the benefits of 21st-century skills (Hadinugrahaningsih, Rahmawati, and Ridwan 2017). One of the vital skills in this 21st century is creativity. Creative thinking skills determine the individual power to exhibit creative behavior, identify a task or problem, understand science as a discipline with specific norms and practices (Ballard, Dixon, and Harris 2017; Guilford 1950; Sirajudin, Suratno, and Pamuti 2021). Creating solution that requires assumptions and arguments will be form by creative thinking skill. Students can realize the importance value of repeatable data collection on science experiments. Creative thinking skill also stimulate to foster another skill such as scientific presentation.

There are four indicators of creative thinking skills by Torrance. Those are flexibility, fluency, originality, and elaboration. Fluency is indicated by student's ability to solve with lots of answers and the number of ideas that are given in a short time (Huang, Chang, and Chou 2020; Sirajudin, Suratno, and Pamuti 2021; Sugiyanto, Masykuri, and Muzzazinah 2018). Flexibility indicates by student's abilities to generate solution from different points of view, different ways of solving a challenge, and generate various ideas, approaches, and perspectives to answer questions (Huang, Chang, and Chou 2020; Nurhalizah et al. 2020; Sirajudin, Suratno, and Pamuti 2021; Sugiyanto, Masykuri, and Muzzazinah 2018). Originality is indicated by student's abilities to show new and unique expressions, generate new ideas and develop existing ideas, and give birth to ideas that are not commonly found in references or submitted by people in general, and provide ideas or answers in their language and way (Alfitriyani, Pursitasari, and Kurniasih 2021; Nurhalizah et al. 2020; Sirajudin, Suratno, and Pamuti 2021; Sugiyanto, Masykuri, and Muzzazinah 2018). Elaboration indicates the level of detail describing an argument, students able to add a solution which more attractive, develop the detailed ideas, itemize ideas or answers given, and add meaning to the argument put forward (Alfitriyani, Pursitasari, and Kurniasih 2021; Huang, Chang, and Chou 2020; Nurhalizah et al. 2020; Sirajudin, Suratno, and Pamuti 2021; Sugiyanto, Masykuri, and Muzzazinah 2018). The crucial

role of creative thinking skills for students is encouraged by thinking to prove the truth of an assessment formulation.

Developing a learning scenario considers the level of creative thinking skills, and its indicator will be meaningful to students. Each creative thinking skill indicator is affected to that level. If teachers already know the fulfilled status of each creative thinking skill indicator, the learning scenario will be generated and focus on specific things that need to increase. Teachers can support students' creativity simultaneously with their academic knowledge (Yayuk et al. 2020). The teacher must analyze students' creative thinking skills.

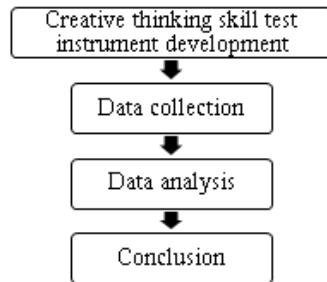
Science is one of the most critical subjects in school. Teachers are responsible for teaching students how to apply science in their daily lives. Teaching science is not a simple process (Nawzad, Rahim, and Said 2018). In this era, science is used to solve environmental problems. One of the most crucial environmental problems is energy. Fortunately, energy is one of the materials in science. Students in junior high school will learn about energy in 7th grade. Students will need creative thinking skills to solve energy problems in this grade. One of the most crucial problems with energy is alternative energy. The increasing energy demand desperately requires alternative energy sources due to the explosive development of industrialization in many countries (Hasran et al. 2018). The teacher must guide students to realize that alternative energy is essential and encourage them to create the solution.

In addition to science content knowledge, environmental issue has the most attention. The youths at all regions demonstrated broader understandings of science as a discipline with specific norms and practices (Ballard, Dixon, and Harris 2017). Practices as a process of creating solutions need creative thinking skills. This research explores junior high school students' creative thinking skill profile in science learning about alternative energy. Teaching and learning scenarios about alternative energy can be created effectively by exploring students' creative thinking skills.

## METHOD

This research is quantitative descriptive research. The data collecting method is the essay test method. The essay test consists of eight questions. Two questions present each indicator of creative thinking skills. An expert has validated both essay test and their rubric. The sample of this research is 7th-grade students of junior high school in Jember, East Java, Indonesia. One hun-

dred ten participants contributed to this research.



**Figure 1.** Research scheme

Each question's maximum and minimum scores on the essay test are 5 and 0, respectively. The total score of the essay test calculates by sum of each question score. The range of the total score is 0 to 40. The level of students' creative thinking skills calculates by converting the entire score to a percentage and indicates the level based on Table 1. Each indicator is measured by ratios and indicated based on Table 1.

**Table 1.** Criteria of creative thinking and each indicator.

Percentage	Criteria
76% - 100%	High
51% - 75,99%	Sufficient
26% - 50,99%	Low
0% - 25,99%	Very Low

Data analyses by IBM SPSS Statistics 23. Analyses used in SPSS are descriptive analyses, frequency analyses, one-sample Kolmogorov-Smirnov test, validity test by person correlation, reliability test, linearity test, and regression analyses. Descriptive analyses will show the range and mean of data. Frequency analyses will show the amount of each essay test score. Analyses of factors that affect creative thinking skills will be done by the literature of earlier research and regression analyses between gender and creative thinking skill value. Terms for regression analyses are normal, valid, reliable, and linear. One sample Kolmogorov-Smirnov test will show significant value and mention either its normal distribution or not. The validation Pearson test will show significant value and mention its validity or not. The Reliable Cronbach alpha test will show significant value and mention whether it's reliable or not. Linearity test by deviation from linearity value will show either it linear or not.

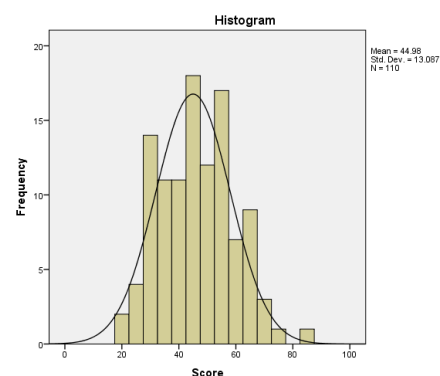
## RESULT AND DISCUSSION

Creative thinking skill is measured by an essay test that consists of eight open-ended questions. Every two questions will figure out one indicator of creative thinking skills. Indicators of creative thinking skills are flexibility, fluency, originality, and elaboration. One hundred ten students from 7th grade already fill the essay test and analyses using descriptive as shown in Table 2.

**Table 2.** Analyses descriptive of test score

	N	Min.	Max.	Mean	Std. Dev.
Score	110	20	83	44.98	13.087
Valid N (listwise)	110				

Based on Table 2, the mean score of the student's essay test is 44.98. Figured out that the creative thinking skill of students is low. It is consistent with the earlier research that states that students' creative aspects need to be developed [12]. Earlier research also appropriates that students' creative thinking skill level is relatively classified as low grade [6]. Teachers can conduct activities and teaching strategies in foster and develop students creative thinking skill. The frequency of each score also showed that most of students' scores were 30 to 62.5, it is shown in Figure 1.



**Figure 1.** Histogram of the score of creative thinking skills

Based on earlier research, creative thinking skills are affected by intelligence (Sugiyanto, Masykuri, and Muzzazinah 2018). The sample of this research is random and gender is the only difference factor, because the sample not divided

into its intelligence level. Gender identities are constituted through relations of social and cultural coherence between sex, gender, sexuality and desire (Blair and Deckman 2019) we ask: How do US preservice teachers (PSTs). Gender differences cause some people to have thoughts about whether the way a person thinks and learns is also different (Muhammad and Nikmah 2021). Gender differences have an influence on the learning outcomes (Sagala et al. 2019). Earlier research found that male student show fluency indicator more impulsive than female student (Widyastuti and Jusra 2022), but another research found creative thinking ability of female students is higher (Muhammad and Nikmah 2021) and found that there are no impact to creative thinking skill (Sotiriou and Bogner 2020). It needs more analysis to find either gender implicated to creative thinking skills or not. Regression analyses are applied to find the effect of gender on creative thinking skills to describe another factor that affects creative thinking skills. Several terms have to be fulfilled. Variables have to be normal, valid, reliable, and linear.

Based on Table 3, all terms are fulfilled. There were 62 male students and 48 female students. Based on Table 4, gender affected creative thinking skills by percentage 0.6%. The Sig in Table 4 is 0.434 and higher than 0.05, which means gender does not affect creative thinking skills. It is linear eith earlier research that found there are not any differences found based on gender (Sari et al. 2019). There are various solutions to develop creative thinking skills. Based on earlier research, creative thinking will improve by being involved in the PBL process, applying the RICOSRE learning model, giving project briefs,

PjBL implementation with Instagram media, and using the STEM education learning approach, combining hands-on experimentation with creative model-construction, the storytelling strategy (Alfitriyani, Pursitasari, and Kurniasih 2021; Ersoy and Baer 2014; Habibi et al. 2020; Marianti and Rahayuningsih 2022; Mierdel and Bogner 2019; Sirajudin, Suratno, and Pamuti 2021; Tabieh et al. 2020) one of the alternatives to the learning activity that could be used as a tool for improving the basic skills needed in this century in Science, Technology, Engineering, and Mathematics (STEM).

Fluency is students' ability to generate ideas or answer in a short time. Junior high school students have a sufficient level of fluency ability. Either in test number 1 or 2, students didn't find any difficult to generate many ideas in a short time. Flexibility is students' ability to create answers or solution from different points of view. Junior high school students have a low level of flexibility. In test number 3 or 4, students find it challenging to generate answers from another approach or point of view. Originality is students' ability to create unique solutions by their language. Junior high school students have a sufficient level of fluency and originality. Students find test number 5 more difficult than number 6. Students have to make their designs without any guidance on test number 5. Test number 6 advises students, and it is easier for students to generate an answer in their way. Elaboration is students' ability to describe ideas in detail and itemize. Junior high school students have a low level of fluency elaboration. In test number 7 or 8, students find it difficult to explain ideas and develop them in detail.

**Table 3.** Value terms before regression analyses

Test	Value	Condition	Result
One sample kol-mogorov-smirnov	Significant	If sig. > 0.05, variables are normal If sig. < 0.05, variables are not normal	Sig. = 0.20 Sig. > 0.05 Variables are normal
Pearson	Significant	If sig. < 0.05, variables are valid If sig. > 0.05, variables are not valid	Sig = 0.00 Sig. < 0.05 Variables are valid
Reliable	Cronbach alpha	If cronbach alpha > 0.6, variables are reliable If cronbach alpha < 0.6, variables are not reliable	Cronbach alpha = 0.668 Cronbach alpha > 0.6 Variables are realiable
Linearity	Sig. deviation from linearity	If sig. > 0.05, variables are linear. If sig. < 0.05, variables are not linear.	Sig. = 0.538 Sig. > 0.05 Variables are linear



**Table 4.** Regression analyses

	Significant	R Square
Model Summary		.006
ANOVA	.434	

**Table 5.** Mean score of essay test

Indicators	Test number	Mean
Fluency	1	51.45
	2	55.82
Flexibility	3	35.09
	4	32.91
Originality	5	32.27
	6	63.64
Elaboration	7	22.73
	8	58.91

**Table 6.** Analyses descriptive of each indicator

Indicators	Percentage (%)	Level
Fluency	53.6	Sufficient
Flexibility	35.2	Low
Originality	51.4	Sufficient
Elaboration	40.9	Low

Under high renewable energy penetration, neglecting the short-term constraints may lead to plans significantly short on flexibility (Abdin and Zio 2018)(ii). Alternative energy can be a suitable science content to develop students' creative thinking skills. Table 6 showed that students could make an original design with a guide. This idea can be implemented in learning scenarios by guiding students to make their design of alternative energy systems step by step. Furthermore, if students accept much guidance, they can make their original design without any advice.

## CONCLUSION

The profile of students' creative thinking skills measured by essay tests is low grade. Fluency and originality are measured in sufficient degrees, but flexibility and elaboration are measured in low grades. Improvement of creative thinking skills will be crucial for teachers, especially in flexibility and elaboration indicators. We suggest that creative thinking skills need to improve by developing learning methods, models, strategies, approaches, media, context, and interaction in the discussion process.

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