

ANALYSIS OF INITIAL PROFILES OF STUDENTS' CREATIVE THINKING SKILLS IN BIOLOGY LEARNING

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Abstract

This study aims to analyze the initial profile of high school students' creative thinking skills in biology learning. The research is descriptive quantitative research using an open-ended test method. The subjects of this study were tenth-grade high school students. The results of the analysis show that the average creative thinking skills of high school students is 37.85%, which is classified as not creative. Specifically, the lowest percentages were found in the aspects of originality, elaboration, and flexibility, while the aspect of fluency showed relatively higher achievements. The conclusion of this study is that the profile of students' creative thinking skills in biology learning is low. These findings indicate that the dominance of convergent learning through closed questions and student passivity in class are factors that inhibit the development of divergent thinking potential. Therefore, it is necessary to apply active learning models and use more exploratory evaluation instruments to stimulate students' ability to produce unique, flexible, and in-depth ideas.

Keywords: Creative Thinking Skills; Biology Learning; Senior High School

1. Introduction

The rapid development of science, technology, and globalization has had a significant impact on the education sector. The education sector is required to produce competitive human resources, so that education no longer focuses solely on mastering knowledge content but also equips students with various 21st-century skills (Varas et al., 2023). One of the most crucial 21st-century skills is creative thinking to face the era of the 4.0 industrial revolution and 5.0 society. This skill is very important for students to develop ideas, improve efficiency, and design solutions to complex problems (Plucker et al., 2004; Ritter et al., 2020). These skills are fundamental and highly essential, based on knowledge and practice, enabling students to achieve better outcomes (Dilekçi & Karatay, 2023; Karunarathne & Calma, 2024).

In reality, creative thinking skills remain relatively low. This is consistent with the results of the creative thinking test conducted by PISA 2022, which was designed to measure three idea processes, namely diversity of ideas, generating creative ideas, and evaluating and refining ideas. The results show that only 5% of Indonesian students are in the best category (Level 5/6) in the PISA creative thinking test (OECD average: 27%) (OECD, 2024). Research conducted by Handayani et al., (2021) found that more than 50% of students were at a low level on all indicators of creative thinking skills in terms of fluency (39.9%), flexibility (13.3%), originality (7.5%), and elaboration (30.8%). The results of this previous study indicate that many students have limitations in these skills, and these results are not in line with the expectations of the 21st century, which requires students to be innovative thinkers.

This low level of creative thinking skills is due to the fact that teachers do not train these skills in the learning process. These skills are still not considered crucial by teachers in the learning process, as reflected in the dominance of routine questions over problem-solving questions (Purwati & Alberida, 2022). Based on the results of interviews with biology teachers, there are still teachers who apply the lecture method, so that the process that occurs emphasises the delivery of information from the teacher to the students. This situation means that students have fewer opportunities to think at a higher level. In fact, these skills can be developed through teacher training and a learning environment that encourages open-ended questions and

links teaching content to real-life applications in order to foster creative thinking in students (Cimermanova, 2015; Horng et al., 2005) .

Creative thinking skills are included in higher-order thinking skills (Makhrus et al., 2019) and continue to be an international focus in the broader context of education (OECD, 2021) . These skills consist of four aspects, namely fluency (generating many ideas or concepts); flexibility (generating varied ideas and moving from one category or perspective to another or seeing problems from various perspectives); originality (the uniqueness and unusualness of the ideas given compared to those given by other participants) and elaboration (the ability to develop, elaborate, and enrich existing ideas by adding details or explanations (Acar et al., 2019; Forthmann et al., 2021; Guilford, 1950; Kasirer & Mashal, 2018; López Martínez et al., 2024) .

Based on this urgency, a comprehensive understanding of the actual state of students' creative thinking skills is needed before undertaking efforts to develop more innovative learning. Therefore, this study aims to analyse the initial profile of high school students' creative thinking skills in biology learning. The results of this initial profile mapping are expected to provide a realistic picture of the strengths and weaknesses of students' creative thinking skills, thereby serving as an empirical basis for designing more effective learning strategies, models, and media to optimally empower creative thinking skills.

2. Research Method

2.1. Object, Time, and Place

The object of this study was tenth grade high school students who participated in a preliminary test of creative thinking skills. This study was conducted in October 2025 at a high school in Sukoharjo Regency. Sampling was conducted using the random sampling technique, involving 36 tenth grade students as research respondents.

2.2. Data Collection Techniques

The students were given a descriptive test to determine their creative thinking abilities, particularly in biology learning. This test used open-ended questions consisting of four items based on indicators of creative thinking abilities, namely fluency, flexibility, originality, and elaboration. The scoring of the test questions in this study referred to the rubric developed by (Aryanti et al., 2021; Purwati & Alberida, 2022).

Table 1. Creative thinking skills assessment rubric

Criteria	Excellent (4 points)	Good (3 points)	Fair (2 points)	Poor (1 point)
Fluency	Providing >3 correct answers, explanations directly lead to action solving the problem	Provides 3 correct answers, with explanations directly leading to action to solve the problem.	Provides 2 correct answers, with explanations directly leading to action to solve the problem.	Provides 1 correct answer, with explanations directly leading to action to solve the problem.
Flexibility	Providing >3 relevant and appropriate answers, the explanation directly leads to action to address the problem.	Providing 3 relevant and appropriate answers, the explanation directly leads to action to overcome the problem.	Providing 2 relevant and appropriate answers, the explanation directly leads to actions to address the problem.	Providing 1 relevant and appropriate answer, with an explanation directly leading to action to resolve the issue.
Originality	Answers are highly unique and complex, with similarity $\leq 10\%$ of all participants'	Unique answer, similarity $\leq 25\%$ of all participants' answers; explicit explanation	The answer is sufficiently unique, with similarity $\leq 50\%$ of all participants'	The answer is not unique, with similarity $> 50\%$ of all participants'

	answers; explicit explanations leading to actions to resolve the issue.	leading to actions to resolve the issue.	answers; the explanation explicitly leads to actions to resolve the issue.	answers; the explicit explanation leads to action to solve the problem.
Elaboration	Adding many logical details so that the solution is clearer, more precise, and easier to implement.	Adding some logical details that make the solution clearer and easier to implement.	Adding logical details but they are not in line with the solution concept, so they do not clarify the idea.	No details are added to the idea, making the solution less applicable.

2.3. Data Analysis Techniques

Test results are analysed using descriptive percentages to identify indicators of creative thinking skills that students have not yet achieved. Calculation of creative thinking skill scores using the formula:

$$S = \frac{R}{N} \times 100$$

Explanation:

S = student's creative thinking skill score

R = total number of correct answers

N = maximum score

Table 2. Categories of creative thinking skills percentages

Percentage (%)	Category
81%-100%	Highly creative
61%-80%	Creative
41%-60%	Fairly creative
21%-40%	Not creative
0%-20%	Very uncreative

Riduwan in Awaliyah, 2023

3. Results and Discussion

3.1. Research Findings

This study was conducted to analyse the initial profile of students' creative thinking skills in senior high school biology learning. This initial profile of skills is represented by four aspects of creative thinking, namely fluency, flexibility, originality, and elaboration, which are measured using open-ended questions to give each student the opportunity to think, generate ideas, and propose unique ideas. Creative thinking can be defined as the ability to generate, evaluate, and improve ideas to produce original and effective solutions, advance knowledge, and express imagination that has an impact (OECD, 2023). The results of the students' initial profile test are presented in Table 3.

Table 3. Initial profile of students' creative thinking skills

No	Indicator	Percentage of creative thinking skills (%)	
		High School	
1	Fluency	45.83	
2	Flexibility	38.89	
3	Originality	27.08	
4	Elaboration	39.58	
Average		37.85	

3.2. Discussion

Based on these results, it is known that the average percentage of creative thinking skills among high school students is 37.85%. This indicates that students' creative thinking skills are still in the non-creative

category. In this case, intelligence level appears to influence creative thinking patterns, because once individuals have reached a certain IQ level, further increases in intelligence no longer play a role in improving these abilities (Akhtar & Kartika, 2019). The findings in Table 3 show that the percentage of fluency is higher than that of originality. This indicates that although students have good ability in producing many ideas (fluency), they still face challenges in generating unique ideas (originality). According to , a higher IQ plays a crucial role in predicting the originality of ideas compared to fluency, so that individuals who have reached the threshold, intelligence is no longer a determining factor in increasing fluency.

The assessment of creative thinking skills in Table 3 shows that some students almost reached the target in terms of fluency with a category of moderately creative. Meanwhile, the percentages for the aspects of flexibility, originality, and elaboration are still in the not creative category. This is in line with the research conducted by (Suciati et al., 2023) with the results showing that the scores for the aspects of flexibility, originality, and elaboration are still relatively low. The low level of these skills is caused by the tendency of teachers to give closed questions that only have one correct answer, so that creative thinking skills are not sufficiently trained (Amelia et al., 2018; Heldina & Alberida, 2021). In fact, these skills involve continuous divergent and convergent thinking phases (Qiang et al., 2020). The use of closed-ended questions directly impacts the low levels of flexibility, originality, and elaboration among students. This occurs because in divergent thinking, students should be encouraged to generate many solutions and broad possibilities. However, because students are accustomed to being directed towards a single answer, they are not accustomed to viewing problems from various perspectives (flexibility), are afraid to express ideas that are different from the norm (originality), and are not accustomed to expanding or elaborating on their ideas (elaboration) (Habib et al., 2024; Mursid et al., 2022).

The results of the high school creative thinking skills test were low, supported by the results of interviews with biology teachers at the school, namely that during the learning process, students tended to be passive. When given stimuli in the form of questions, most students rarely expressed ideas or answers, and were not accustomed to expressing unique ideas or expanding on existing ideas with more in-depth explanations. Therefore, to empower creative thinking skills, teachers need to familiarise students with the use of open-ended questions and relate learning materials to their application in everyday life so that students' creative thinking patterns can develop (Cimermanova, 2015; Horng et al., 2005). This study indicates that open-ended questions provide students with the opportunity to freely express diverse ideas based on their existing knowledge, thereby potentially enhancing their creative thinking abilities.

3.3. Relevance to Research Objectives

The results of this study show strong relevance to the initial research objective, which was to analyze the initial profile of high school students' creative thinking skills in biology learning. The data findings, which show an average score of 37.85%, empirically confirm that students' creative thinking skills fall into the non-creative category. This low achievement answers the research question regarding the map of students' actual abilities in the field, while also revealing a significant gap between the demands of the 21st-century curriculum and the reality of students' higher-order thinking skills. The dominance of the non-creative category indicates that the biology learning process that has been taking place may still be conventional or more focused on low-level cognitive aspects (memorization), so that it has not been able to stimulate students' fluency, flexibility, and originality. Thus, this initial profile provides a strong basis for the urgency of developing innovative learning strategies or models specifically designed to intervene and enhance students' creative potential in biology.

4. Conclusion

The conclusion of this study is that the initial profile of students' creative thinking skills in biology learning is still in the non-creative or low category, so that students' divergent thinking potential has not been optimally honed. This is indicated by low achievement in the aspects of flexibility, originality, and elaboration compared to the aspect of fluency. This condition is triggered by the use of closed questions and low active participation of students in class. Therefore, it is necessary to habituate the use of open-ended questions and a more exploratory learning approach to trigger the emergence of unique and in-depth ideas from students.

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