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Profile of Creative Thinking Skills and Analysis of Students' Perceptions of Physics Learning

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Abstract: This study aims to describe the profile of students' creative thinking skills in Physics and analyze their perceptions of Physics learning. The method used is descriptive quantitative involving 59 high school students selected through random sampling techniques. The instruments used include creative thinking skills tests and student response questionnaires that are analyzed using descriptive statistics. The results of the study indicate that in general students' creative thinking skills are in the moderate category with an analysis per aspect, where "originality" obtained the highest percentage, while "flexibility" showed the lowest value. There was no significant difference between the creative thinking skills of male and female students. From the results of the questionnaire, some students stated that Physics lessons were still considered difficult and the learning was less innovative. Although most students have experience in working on projects, the implementation of mini projects is still considered necessary to optimize the development of creative thinking skills. These findings can be the basis for further research in developing project-based learning models to improve students' creative thinking skills in Physics learning in high school.

Keywords: 21st-Century Skills; Creative Thinking; Physics Learning; Perception

Introduction

The rapid development of science and technology in the 21st century encourages efforts to improve the quality of human resources (Purwanto et al., 2023). One of the efforts made is to provide high-quality education for the next generation in accordance with the demands of global development (Chankseliani et al., 2021). This must be done because jobs in this century demand more non-routine skills and are based on complex human interactions (Thornhill-Miller et al., 2023). Therefore, learning in this century, especially science learning, needs to prioritize several skills that students must be able to master and can be used to face the development of global life today (Berg et al., 2021). According to the Framework for 21st Century Learning, the skills that students need to master in this century include creativity and innovation skills, critical thinking and problem solving skills, communication and collaboration skills (Purwanto et al., 2023; Tohani & Aulia, 2022; Peña-Ayala, 2021).

Creative thinking skills are known as one of the vital skills of the 21st century that students must have in the era of globalization (Gafour & Gafour, 2020). Creative thinking is the ability of students to understand problems and find solutions by using various strategies or methods (Kardoyo et al., 2020). ACER also defines creative thinking as the ability to generate a variety of ideas, experiment with ideas, and explore how these ideas can produce new and effective responses to challenges and solutions to problems (Heard et al., 2025). According toTorrance (1987)Creative thinking skills consist of four indicators, namely 1) fluency; 2) flexibility; 3) originality; and 4) elaboration with the characteristics of creating and developing ideas or information and applying them to solve various problems (Li & Tu, 2024; Chang et al., 2022; Jumadi et al., 2021). Therefore, with creative thinking skills, a person

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is able to solve global complex problems in the future (Aini, 2024; Akmam et al., 2024). In addition, creative thinking skills are also important for students to have in order to increase honesty (Eshet & Margaliot, 2022). Creative thinking is also a form of high-level thinking (Kenett, 2024). By having high-level thinking skills, students are able to solve problems, be creative, and make decisions about something. Therefore, it is increasingly clear that creative thinking skills are very important skills for students to have in order to succeed in facing real-world problems that are increasingly complex and require high integrity.

There has been previous research that examines the profile of students' creative thinking skills. From these results, it was found that students' creative thinking skills are still low, which is influenced by learning styles and gender which have an impact on students' academic performance (Musdi et al., 2024; Jumanto & Adi, 2023; Damira & Alberida, 2022). It is very important to be able to improve students' creative thinking skills. This is the main task of science including current physics learning to support the development of students' creative thinking skills under the influence of globalization (Botagariyev et al., 2023). Physics learning plays an important role in developing students' creative thinking skills (Satriawan et al., 2020). Through exploration of physics concepts, students are encouraged to think critically, solve problems, and generate innovative ideas (Hikmah et al., 2023). The level of effectiveness of the role of physics learning in improving creative thinking skills cannot be separated from students' perceptions of physics learning. Students' perceptions of learning have a crucial role in shaping their learning motivation. Positive or negative perceptions of the learning process will affect the level of student involvement in learning activities and the academic results achieved (Bøe et al., 2024; Pečiuliauskienė, 2023).

Based on the previous description, it is necessary to study the level of mastery of creative thinking skills among students in learning in order to carry out appropriate learning interventions to train and improve these skills. Therefore, the purpose of this study is to determine the profile of students' current creative thinking skills in physics learning and students' perceptions of physics learning that has been obtained so that it can be used to develop models, methods or physics learning media that can be used to improve students' creative thinking skills.

Method

This research is quantitative descriptive research. The purpose of this research is to determine the profile of creative thinking skills and students' perceptions of Physics learning. The population of this research is all high school students in East Nusa Tenggara and the sample of this research is 59 students (37 males; 22 females) from three different high schools in East Nusa Tenggara. One of the three schools is a private school and the rest are public schools that study Physics material. The sample selection technique uses random sampling. The instruments used in data collection are creative thinking skills tests and questionnaires about students' perceptions of Physics learning. The test instrument used is a creative thinking skills test on Newton's Laws of Motion material developed by Martina (2019) with 4 aspects of creative thinking skills from Torrance (1987) includes fluency, flexibility, originality, and elaboration, totaling 4 questions, with each question getting a score of 1, 2, 3, and 4 according to the assessment criteria. Meanwhile, the questionnaire uses a student response questionnaire in the form of a Likert scale developed by Suprapto et al. (2024) which consists of 5 statements regarding the description of Physics learning with a scale of 1-6 (1 = strongly disagree; and 6 = strongly agree).

The profile of creative thinking skills and students' perceptions of physics learning were analyzed using descriptive statistical data analysis techniques. The profile of creative thinking skills was analyzed by converting the test scores obtained by students into percentages, then adjusted and described based on each criterion of creative thinking skills. The classification of the criteria for the results of the percentage analysis of creative thinking skills used the percentage levels shown in Table 1.

Table 1. Creative Thinking Skills Percentage Level

Percentage	Criteria
81%-100%	Very Creative
61%-80%	Creative
41%-60%	Currently
21%-40%	Low

(Nurdiana et al., 2020)

Then for a more in-depth profile of students' creative thinking skills based on gender, statistical analysis of normality, homogeneity, and Mann-Whitney tests using IBM SPSS Statistics 27.0 was carried out. Furthermore, for student perceptions, all student answers will be calculated and entered in the form of percentages and all student responses will be described.

Results and Discussion

The profile of students' creative thinking skills and students' perceptions of physics learning were studied through several processes that began with students working on four creative thinking skills test questions on Newton's Laws of Motion and then students were given

a Google form questionnaire containing five statements about Physics learning.

General Profile of Students' Creative Thinking Skills in Physics

The results of the analysis of students' creative thinking skills tests can be shown in Figure 1.

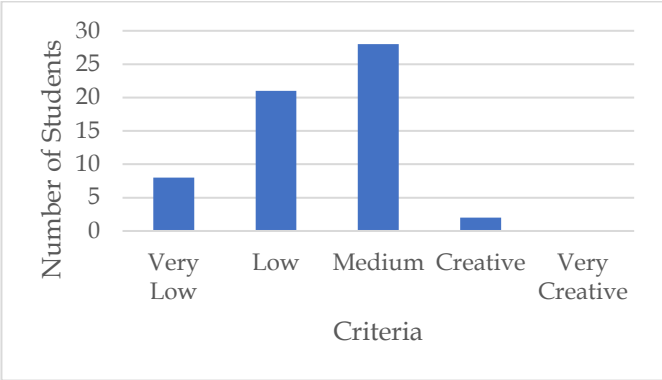


Figure 1. Graph of Creative Thinking Skills Profile of Students in Physics Based on the Number of Students

Based on the data in Figure 1, it is known that students' creative thinking skills are included in the moderate category with the largest number of students, followed by the low, very low and creative categories and none of the students are included in the very creative category. This shows that most students have creative thinking skills but are still low.

Profile of Students' Creative Thinking Skills in Physics Based on Aspects

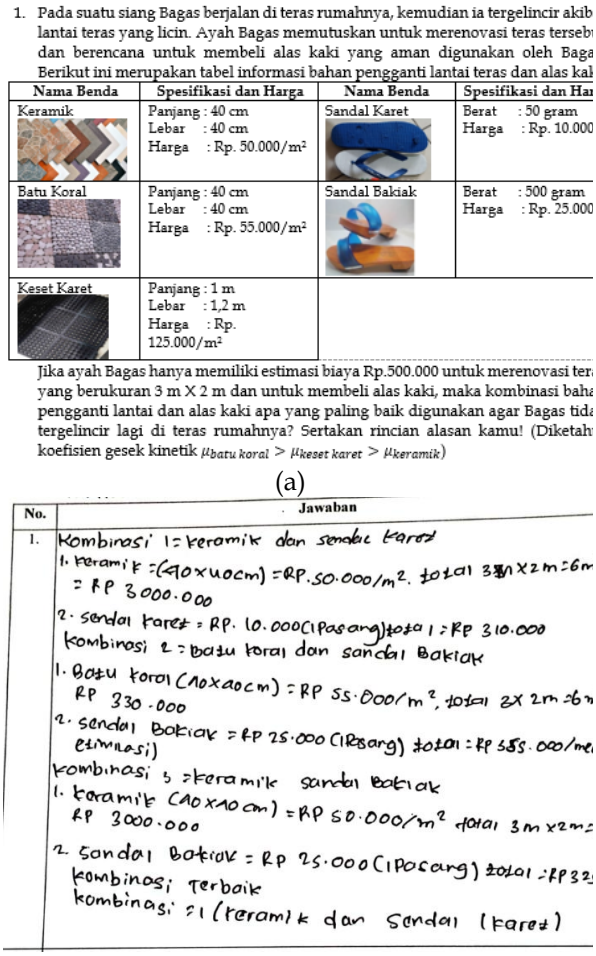
The results of the analysis of students' creative thinking skills based on each aspect can be shown in Table 2.

Table 2: Average Percentage of Creative Thinking Skills of Students in Each Aspect

Aspect	Percentage	Category
Fluency	24.15	Low
Flexibility	19.49	Very Low
Originality	61.02	Creative
Elaboration	44.07	Currently

Based on the data in Table 2, the aspect with the highest percentage result is originality, followed by the elaboration aspect, followed by the fluency aspect and the lowest percentage in the flexibility aspect. In the fluency aspect, students are expected to be able to fluently produce problem solution ideas, then in the flexibility aspect, students are expected to flexibly provide various ideas, then in the originality aspect, students can provide original ideas, and in the elaboration aspect, students can develop ideas in detail and depth. (Chang et al., 2022).

The aspect of students' thinking fluency is classified as low with a percentage of 24.15%, indicating that there are still few students in producing solution ideas and appropriate reasons in solving problems, especially related to reducing friction as shown in Figure 2. This reflects limitations in developing ideas quickly and in a variety of ways, so special training is needed such as brainstorming, idea exploration and group discussions.(Hasanova, 2024; Gong et al., 2022).


1. Pada suatu siang Bagas berjalan di teras rumahnya, kemudian ia tergelincir akib lantai teras yang licin. Ayah Bagas memutuskan untuk merenovasi teras terseb dan berencana untuk membeli alas kaki yang aman digunakan oleh Baga Berikut ini merupakan tabel informasi bahan pengganti lantai teras dan alas kak

Nama Benda	Spesifikasi dan Harga	Nama Benda	Spesifikasi dan Ha
Keramik	Panjang : 40 cm Lebar : 40 cm Harga : Rp. 50.000/m²	Sandal Karet	Berat : 50 gram Harga : Rp. 10.000
Batu Koral	Panjang : 40 cm Lebar : 40 cm Harga : Rp. 55.000/m²	Sandal Bakiak	Berat : 500 gram Harga : Rp. 25.000
Keset Karet	Panjang : 1 m Lebar : 1,2 m Harga : Rp. 125.000/m²		

Jika ayah Bagas hanya memiliki estimasi biaya Rp.500.000 untuk merenovasi ter yang berukuran 3 m X 2 m dan untuk membeli alas kaki, maka kombinasi baha pengganti lantai dan alas kaki apa yang paling baik digunakan agar Bagas tida tergelincir lagi di teras rumahnya? Sertakan rincian alasan kamu! (Diketah koefisien gesek kinetik $\mu_{batu\ koral} > \mu_{keset\ karet} > \mu_{keramik}$)

(a)

(b)

Figure 2. (a)Questions on the aspect of fluency; (b)examples of student answers

The percentage of the flexibility aspect of 19.49% is included in the very low category, indicating that students have difficulty thinking flexibly and seeing problems from various perspectives. They have not been able to provide diverse answers related to Newton's First Law or the Law of Inertia as seen in Figure 3. To develop this skill, teachers can use open or divergent questions that encourage exploration of various solutions and perspectives. This strategy fosters innovative thinking, as it encourages students to seek solutions outside of traditional methods and enhances their creativity.(Zhang et al., 2024; Septiani et al., 2022).

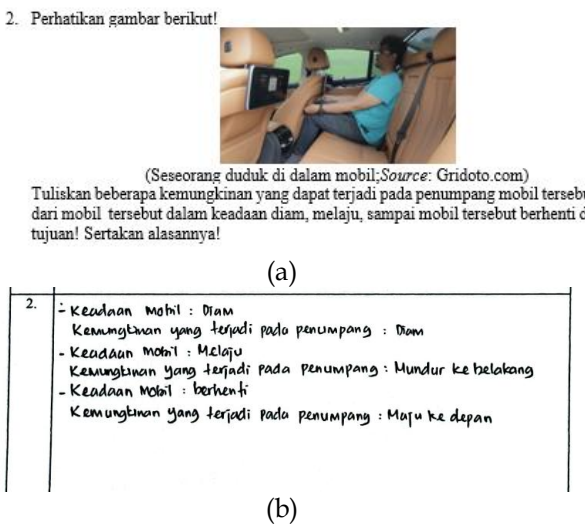


Figure 3. (a) Questions on the flexibility aspect; (b) examples of student answers

The originality aspect shows the highest percentage of 61.02% and is included in the creative category, indicating that most students are able to produce unique ideas, especially in applying Newton's Third Law as shown in Figure 4. This ability needs to be maintained and developed through learning activities that encourage innovation, such as the Creative Problem Solving, Discovery Learning, and Project-Based Learning models, which have been proven to be effective in increasing originality through active involvement and direct experience.(Juliangkary et al., 2024; Luthfia, 2024; Wardhany & Muhid, 2024). These models promote active engagement and collaboration, allowing students to explore and develop original ideas through hands-on experiences.

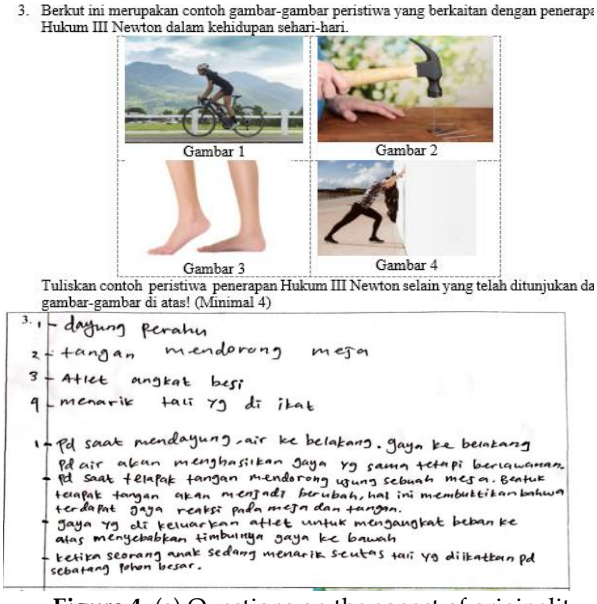


Figure 4. (a) Questions on the aspect of originality (Originality); (b) examples of student answers

The last aspect is elaboration which obtained a percentage result of 44.07% with a moderate category. In the elaboration aspect, students showed moderate abilities in detailing and developing ideas. Most students have not been able to describe the details of the action-reaction force vector in the application of Newton's Third Law, but can explain the details. These results indicate the potential to improve this skill through exercises that involve detailed planning and concept development. This aspect can also be trained by implementing learning strategies such as Creative Problem Solving, Discovery Learning, and Problem Based Learning which can significantly improve creative thinking skills by encouraging students to actively explore and build knowledge, promoting deeper understanding or elaboration.

The elaboration aspect obtained a percentage of 44.07% and was categorized as moderate, indicating that students were quite capable of developing and detailing ideas. Most of them were not yet able to describe the details of the action-reaction force vector in Newton's Third Law as shown in Figure 5, although they could explain it. This skill can be improved through practice and learning strategies such as Creative Problem Solving, Discovery Learning, and Problem Based Learning, which encourage active exploration and in-depth understanding.(Wardhany & Muhid, 2024).

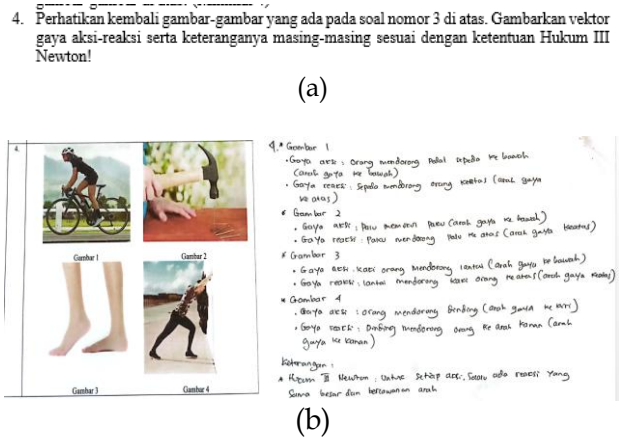


Figure 5. Questions on the elaboration aspect (Elaboration) and examples of student answers

Creative Thinking Skills Profile by Gender

Based on the results of the Kolmogorov-Smirnov normality test analysis and the homogeneity test with Levene's Statistics in Table 3, it shows that the male student group data is not normally distributed, while the female students are normally distributed and both are homogeneously distributed.

Table 3. Normality, Homogeneity and Mann-Whitney Analysis by Gender

Gender	Normality		Homogeneity		Mean	Mann-Whitney U
	Sig.	Criteria	Sig.	Criteria		Sig.
Man	0.049	Abnormal	0.672		22.41	
Woman	0.206	Normal		Homogeneous	31.24	0.365

To determine the significance of the differences in creative thinking skills between male and female students, a non-parametric statistical type was used, namely the Mann-Whitney U Test. The data in Table 3 shows that the average score of female students' creative thinking skills (31.24) is higher than that of male students (22.41). However, statistically, the results of the Mann-Whitney U test show a significance value of p = 0.365 <0.05 so that the conclusion that can be drawn is that there is no significant difference between the creative thinking abilities of male and female physics students. In this case, each group of male students and the group of female students obtained low scores. Therefore, this study can be continued by implementing more innovative learning and building student creativity (Wulandari et al., 2021).

Student Responses About Physics Learning

The results of the analysis of student response data based on five student statements are described in Table 4. Based on the results of the percentage of student responses, there is a perception that there are still students who experience difficulties in learning physics. Perception is the cause of students' lack of motivation to learn physics. In fact, studies show that students with high motivation show better creative thinking skills, which leads to better learning outcomes (Sinaga & Simorangkir, 2024).

Then, many students feel that the physics learning methods used by teachers are less innovative, this is in line with research by Ulfa et al. (2024) which states that the reality in the field of learning used by teachers still uses conventional learning and is centered on the teacher. The next statement is about project-based learning, most students think that they have done project-based assignments. Through project-based learning, students are more active in collaborating and solving complex problems with real product results (Supratno et al., 2024). Therefore, most students agree to apply a kind of mini project in physics learning. In addition, they also believe that projects can improve creative thinking skills in physics learning.

Table 4. Student Responses to Questionnaire Data

Statement	Student Response (1= Strongly disagree; 6 = Strongly agree)					
	1	2	3	4	5	6
I find Physics very difficult	16.05%	17.28%	22.22%	8.64%	4.94%	3.70%
The physics learning methods used are not very innovative so I feel bored	20.99%	19.75%	13.58%	3.70%	6.17%	8.64%
During Physics class, I never got and did project assignments.	37.04%	16.05%	7.41%	3.70%	3.70%	4.94%
I agree with the implementation of mini projects in Physics learning.	6.17%	6.17%	6.17%	4.94%	13.58%	35.80%
I agree that the mini projects given can improve my creative thinking skills in learning Physics.	6.17%	3.70%	4.94%	7.41%	12.35%	38.27%

Conclusion

The profile of students' creative thinking skills in physics is generally included in the moderate category. Students already have creative thinking skills but need to be improved by teachers. More specifically based on aspects, students' creative thinking skills get better or higher results in the "originality" aspect and the lowest in the "flexibility" aspect. Meanwhile, statistical tests show that based on gender, both male and female students do not have significant differences in creative thinking skills. Both get average results in the low category. The results of the student response questionnaire show that there are still students who consider physics lessons very difficult. Most students have done project assignments in physics lessons. But they also need the application of a kind of mini project in physics learning to improve their creative thinking skills. Specifically, the implications of this study are 1) it can be a guide for teachers to be better able to train creative thinking skills according to aspects of creative thinking skills to students; 2) there needs to be an increase in students' creative thinking skills in physics; 3) further research needs to be done on the application of project-based learning models in improving students' creative thinking skills in physics. In short, Physics learning in high school also needs to pay more attention to the needs of learning development that is adjusted to the needs to improve students' creative thinking skills.

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Author Contributions
This research is one source of information about creative thinking skills and students' perceptions about physics learning which can be a reference for future research.

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Conflict of Interest
There are no conflicts of interest

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