



## Preliminary Study of College Students' Creative Thinking Skills on Electromagnetic Material

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### ABSTRACT

**Objective:** This study aims to analyze the initial ability of student's creative thinking skills on electromagnetic materials and find a solution method of learning model suitable to the students' conditions. **Method:** The design of this study was pre-experimental. The data collection technique used a test method using creative thinking skills test instrument. The test instruments used in this study were tested for validity and reliability before use. **Results:** The results of this study showed different results. The percentage of the fluency indicator is 96.71% in the very good category, the percentage of the flexibility indicator is 51.97% in the medium category, the percentage of the elaboration indicator is 36.18%, and the originality is 16.45% in the less category. The average of all indicators is 50.32%, with the medium category. **Novelty:** Students' creative thinking skills can be developed through various methods, including the PjBL model, the Inquiry Social Learning model, PBL combined with Flashcard media, and PjBL integrated with STEM-based e-learning. The implications of this study can be used as a reference and essential alternative for future researchers to design learning tools using specific learning methods/models to increase students' or college students' creative thinking skills.

## INTRODUCTION

Creativity is crucial to a prospective teacher's success in becoming a competent teacher. Creativity can be a person, a process, a motive, or a product. This process stage involves creative thinking (Priyambodo et al., 2021). Creative thinking is a (dynamic) mental activity that moves progressively over time and alternates between convergent and divergent thinking (Dumas et al., 2021). Every student should develop creative thinking skills because it is one of the abilities required to meet the demands of the twenty-first century. In 21st-century learning, there are four crucial talents for every individual to master: critical thinking and problem-solving skills, creative thinking, communication, and collaboration (referred to as the 4C skill) (Lestari, 2021). As a result, creative thinking skills become one of the skills that must be well learned.

Creative thinking abilities are required for physical learning. Determinement and confidence in tackling a challenge can be developed through creative thinking (Saadah et al., 2019). Individuals with a high level of creativity can solve issues (Iskandar et al., 2020). Creative thinking skills are required for physics learning. Individuals with creative thinking talents can freely use their imaginations to develop new ideas, possibilities, and innovations, which can be fundamental or abstract notions (Ozkan & Topsakal, 2019). Torrance identifies fluency, flexibility, originality, and elaboration indicators of creative thinking ability (Ramdani & Artayasa, 2020).

Fluency is the ability to list numerous problem-solving alternatives. Flexibility means providing different responses to problems. Originality means developing new solutions or answers that have never been utilized before to address difficulties, and elaboration means mentioning the entire solution (Widodo et al., 2021). Every country faces

education issues, but education aims to improve human resources because learning is a comprehensive, adaptive process that results from human interaction (Herrera-Pavo, 2021).

Many research results show low creative thinking skills. This condition is caused by several factors, such as using learning models that do not encourage students to think deeply (Biazus & Mahtari, 2022). One of them is that learning in certain institutions is still centered on concepts and assignments, leaving students with little room to express their creativity (Perdana, 2020). According to a survey done at a high school in Central Java, Indonesia, printed books are still the primary form of learning media used there, and the ability of the teaching staff to integrate technology into the classroom is also quite limited (Saryadi & Sulisworo, 2023). To solve these issues, we need educators with the capacity for innovative thought. However, potential teachers still have some restrictions. According to Artayasa (2017)'s research on Elementary School Teacher Education students at Mataram University, the skill score in creating science experiments was around 50.00%, including the not good category. Additionally, some studies reveal that teachers' abilities to plan scientific experiments still need to improve, so they rarely allow students to conduct experiments in the classroom (Arini & Darmayanti, 2022). Some of these studies suggest that potential instructors should practice creative thinking skills. The purpose of this study is to examine the initial ability of creative thinking skills of college students at one of the universities in Surabaya, Indonesia, precisely in Electromagnetic Materials, and find a solution method of learning model that is suitable to the students' conditions.

## RESEARCH METHOD

This study's design was pre-experimental. This preliminary investigation was carried out to detail campus conditions and problems (Shorey, 2020). The main goal of this study is to evaluate students' initial capacity for creative thinking on electromagnetics in learning electricity and magnetism and to identify improvement opportunities to teaching methods and models to provide a suitable learning environment for students. The participants in this study were 19 third-semester science college students from a university in Surabaya, Indonesia. The validity of the test items for creative thinking skills is listed in Table 1.

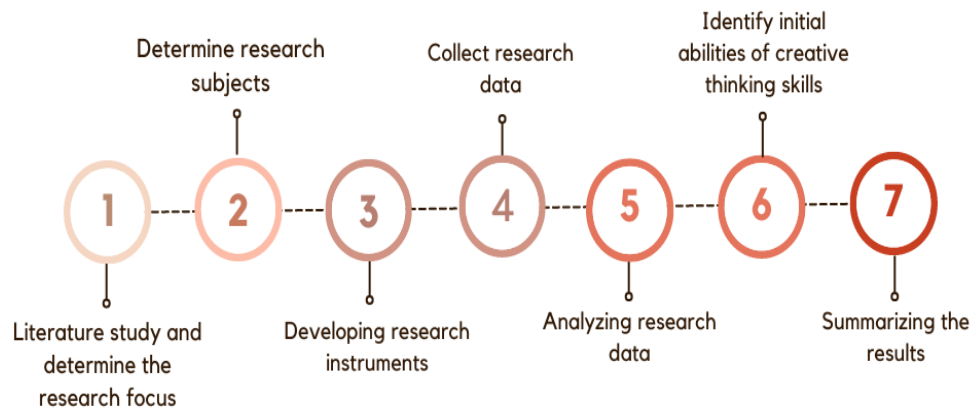
**Table 1.** The results of the validity of the items on the creative thinking skills test

No.	$r_{\text{count}}$	$r_{\text{table}}$	Interpretation
1	0.576		Enough
2	0.465		Enough
3	0.504		Enough
4	0.647	0.455	High
5	0.649		High
6	0.494		Enough
7	0.690		High
8	0.508		Enough

The data collection technique used a test method using creative thinking skills test instrument. The test instruments used in this study were tested for validity and reliability before use. The validity of the test questions for creative thinking abilities is assessed. This was done with the help of the SPSS Product Moment Pearson sign 0.05 to assess the validity of each item. The test instrument includes eight questions about

electromagnetics and four measures of creative thinking skills, including fluency, flexibility, originality, and elaboration.

Question items suitable for use have sufficient to very high validity standards (Arikunto, 2018). It is valid if the calculated *r*value is higher than the *r*table. If the test questions are valid, reliability is tested using SPSS Cronbach alpha, with the result that the reliability test coefficient value is 0.69 in the moderate category. The item is reliable if the value is > 0.60 (Ghozali, 2016).



**Figure 1.** Flowchart research procedure.

This research focused on analyzing students' preliminary creative thinking skills on electromagnetics in the study of electricity and magnetism and identifying improvement opportunities to teaching methods and models to provide a suitable learning environment. The first stage of this research was a literature review, which formed the research's focus. The next step is to gather the required research tools, including learning materials and test items for creative thinking skills. The stage of collecting research data comes next. This stage requires at least two direct learning in class. The next step is analyzing the research data, which includes looking at students' preliminary creative thinking skills on electromagnetics in learning. The last step of this research was to summarize the findings. The results of the ability score of creative thinking abilities were then converted to percentages and categories of creative thinking skills, as shown in Table 2 (Efendi & Farlina, 2017).

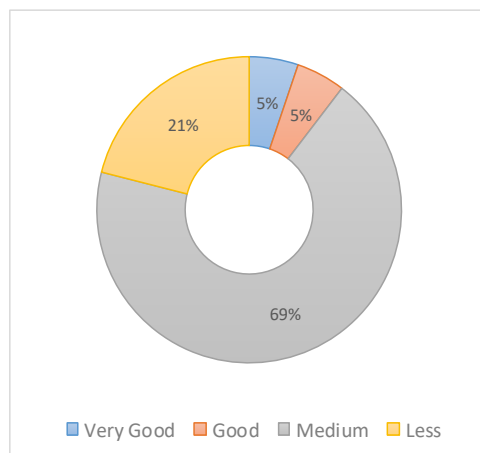
**Table 2.** Tables interpretation level of creative thinking.

Percentage of Creative Thinking Indicators Achieved (%)	Creative Thinking Category Level
81 - 100	Very Good
61 - 80	Good
41 - 60	Medium
21 - 40	Less
0 - 20	Very Less

## RESULTS AND DISCUSSION

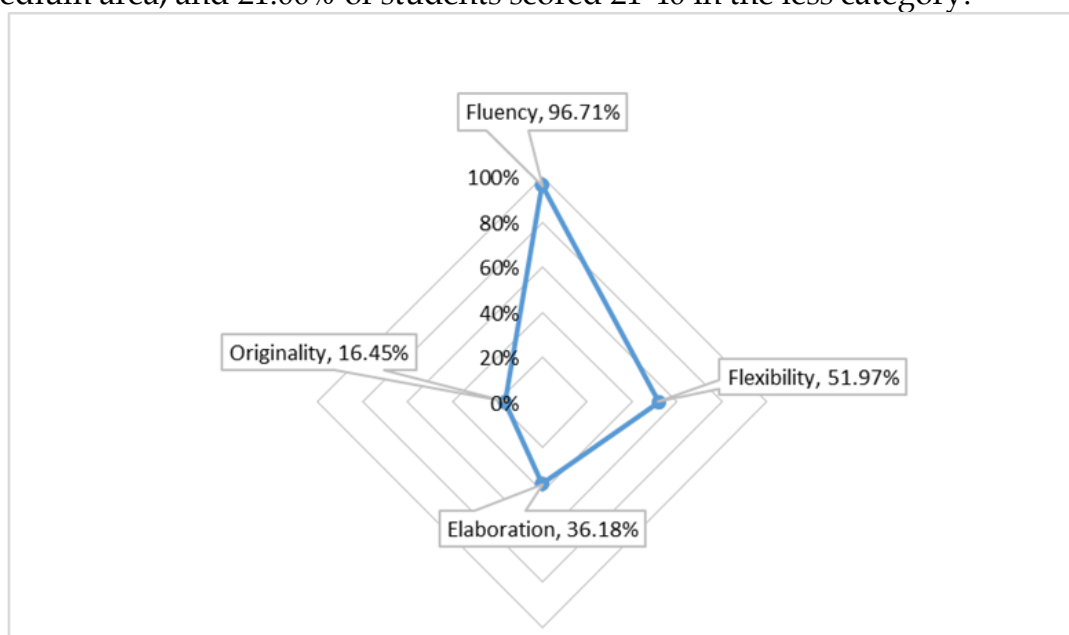
### Results

The initial ability of college students' creative thinking skills produced mixed results. Figure 2 shows the results when the percentage of the capacity for original thought on the electromagnetic matter is expressed as an overall value, as in Figure 2.



**Figure 2.** Graph showing the beginning capacity of creative thinking skills outcomes.

According to the Figure 2, 5.00% of students scored 90.00 in the very good category, 5.00% of students scored 71.00 in the good category, 69.00% of students scored 41-60 in the medium area, and 21.00% of students scored 21-40 in the less category.



**Figure 3.** A radar graph of students' initial abilities related to creative thinking skills.

Figure 3 depicts a radar graph of college students' initial abilities related to creative thinking skills, with fluency representing the highest percentage indicator and originality representing the lowest percentage signal. The fluency indication percentage is 96.71% in the very good category, the flexibility indicator percentage is 51.97% in the medium category, the elaboration indicator percentage is 36.18%, and the originality indicator percentage is 16.45% in the less category. Three of the four indicators are still at low levels.

### Discussion

Fluency is the capacity to produce as many ideas and answers to problems as possible (Altan & Tan, 2021; Nugroho et al., 2020; Yayuk et al., 2020). Creative thinking skills

markers fluency in electromagnetic matter received the highest percentage among all indicators. This is because, in this sub-test, college students are requested to write as many answers as possible about various types of magnets and instances of materials resistant to magnetic forces. A person has a high fluency indicator if he can supply numerous possible responses, ideas, and solutions to a given situation. According to (Larasati et al., 2019), issues with fluency indicators cause people to generate ideas when responding to inquiries.

The ability to respond from several perspectives is called flexibility (Khalid et al., 2020). A person is said to have a high flexibility ability if he can produce variations of solutions that are out of the box but still correct in concept. College students are given problems relating to the phenomenon of aurora and power towers in this sub-test. The college students were then requested to write logical and meaningful replies to the provided problems from various perspectives. College students' responses varied, but they still reached a percentage of 51.97% in the medium category. In a broad sense, issue-solving with thorough stages is evidence of creative thinking abilities elaboration. It is necessary to be able to create and detail details for the elaboration aspect. The researchers assessed the college student's capacity to conduct comprehensive procedures on the working principle of the speaker and how the transformer can work utilizing direct current in this sub-test (DC). Because many college student responses do not provide a lengthy explanation, the percentage of elaboration is 36.18%. The ability of a person to generate new and distinct ideas is referred to as originality. An inventive new idea combines originality and renewal. In other words, it has never existed. The lowest percentage of 16.45% was obtained in this subtest. According to data analysis results, many college students must answer the originality sub-test, resulting in poor scores. Trianggono (2019) said that the originality indication is challenging to assess because it is only sometimes if the answer supplied is a novelty. Thus, the assessment used as a benchmark is simply the unique side of the answer.

Overall, the analysis of college students' creative thinking skills produced an average achievement of 50.32% in the medium category. As a result, college students' first ability to think creatively about electromagnetic matter is still low. This conclusion is consistent with the study by (Nurdiana et al., 2020), which shows that a fluency percentage of 47.00% is in the medium group, while the other three elements are in a low category, with the flexibility of 26.94%, originality of 21.24%, and elaboration of 29.11%. Based on the findings of college student interviews, it was determined that some college students thought physics classes were challenging. This results from the numerous abstract formulas and concepts involved in understanding physics.

Additionally, this aspect of physics classes affects how motivated students are and how well they learn (Hidayat et al., 2019). However, learning physics is a task that can enhance students' creative thinking skills, so a teacher must create instructional materials that can enhance students' creative thinking skills (Mrshel & Ratnawulan, 2020). Everyone has the capacity for creativity (Doa et al., 2018). Creative people can develop ideas and find numerous solutions to issues (Wechsler et al., 2018).

This finding is consistent with Aryanti's research (2021), which found that high school students' creative thinking skills in biology learning are still low at the start of learning. According to a study by Rodriguez et al. (2019), undergraduate students who used the flipped classroom method learned more than those who used traditional teaching methods. Creative thinking abilities can also be enhanced by using suitable media. Technology use in education can lead to innovative changes in communication

and learning methods that can raise the standard of instruction (Rahmawati, 2019). Learning with Google Classroom materials is reportedly valid, practical, and effective, which significantly boosts creative thinking abilities (Hasnah et al., 2021).

College students' creative thinking skills must be developed to formulate ideas or ideas to solve problems encountered during the learning process. According to (Ridlo et al., 2020), creativity requires six interrelated aspects, including 1) knowledge to know everything, 2) intellectual ability includes generating, evaluating, and executing ideas, 3) thinking style, 4) motivation to create a pleasant environment, 5) personality such as perseverance to face challenges, and 6) supportive environment such as the use of instructional media. Several studies have examined several methods that can be used to train creative thinking skills (Wuladari, 2021), including 1) the Project Based Learning (PjBL) model significantly increased the creative thinking skills of high school students in temperature and expansion materials (Biazus & Mahtari, 2022); 2) the Inquiry Social Learning model helped enhance the creative thinking skills of senior high school students in Indonesia (Perdana et al., 2020). 3) The use of Project Based Learning in STEM activities such as manufacturing water purification filters improves students' creative thinking abilities (Ridlo et al., 2020); 4) The use of the Problem-Based Learning (PBL) learning model combined with Flashcard media improves students' creative thinking abilities (Khairunnisa et al., 2022) and website can improve students' problem-solving skills (Pristianti & Prahani, 2022) 5) Project-based learning (PjBL) and STEM-based online learning can be combined to improve students' ability for creative thinking (Hasibuan et al., 2022; Tran et al., 2019). The design and implementation of the mDPBL learning method can help students develop their creative thinking skills (Kusumawati et al., 2023).

## CONCLUSION

**Fundamental Finding:** According to the research findings, the initial capacity of college students' creative thinking skills for each indication exhibited varied results. Fluency has the highest percentage indicator, and originality has the lowest percentage indicator. The fluency indicator percentage is 96.71% in the very good category, the flexibility indicator percentage is 51.97% in the medium category, the elaboration indicator percentage is 36.18%, and the originality indicator percentage is 16.45% in the less category. The average of all indicators is 50.32%, with the medium category. As a result, it may be inferred that students' first ability to think imaginatively about the electromagnetic matter is still low. **Implication:** Based on the research's results, teachers should be able to facilitate teaching and learning that is matched to each student's needs to assist them in improving their ability for creative thought. Students' creative thinking skills can be developed through various methods, including the PjBL, Inquiry Social Learning models, PBL models mixed with Flashcard media, and PjBL with STEM-based e-learning. **Limitation:** This study is limited to the validity and reliability testing of the test items, which are subsequently utilized to measure the responder students' first creative thinking skills. **Future Research:** The results of this study can be used as a reference and a primary alternative for future researchers who create educational tools that improve students' creative thinking skills.

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