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APPLICATION OF THE CREATIVE PROBLEM SOLVING MODEL IN SOUND WAVE INSTRUCTION TO ENHANCE SENIOR HIGH SCHOOL STUDENTS' CREATIVE THINKING SKILLS

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Abstrak- This study aims to analyze the effect of the Creative Problem Solving (CPS) learning model on students' creative thinking skills in sound wave material. This research employed a quasi-experimental method using a post-test only control group design. The study was conducted in the second semester of the 2025/2026 academic year at SMAN 15 Pekanbaru. The population consisted of 145 eleventh-grade students, while the sample included two classes selected using simple random sampling, namely the experimental class (38 students) and the control class (35 students). The method involved the implementation of the CPS model in the experimental class and conventional learning in the control class. Data were collected using an essay-based creative thinking test. The results showed that the average creative thinking score of students in the experimental class was 2.89 (categorized as creative), which was higher than that of the control class with a score of 2.34 (categorized as moderately creative). The Independent Sample t-test revealed a significance value of less than 0.05, indicating a significant difference between the two groups. In conclusion, the Creative Problem Solving (CPS) learning model is effective in improving students' creative thinking skills in sound wave learning.

Keywords: *Creative Problem Solving, creative thinking, sound waves, physics learning*

1 Introduction

Education in the 21st century faces increasingly complex challenges due to rapid technological advancements, globalization, and evolving workforce demands. Educational systems are no longer solely expected to produce graduates with high cognitive abilities, but also individuals who possess creativity, critical thinking, communication, and collaboration skills (Trilling & Fadel, 2009). Creative thinking skills have become one of the essential competencies that must be developed in the learning process, as they are closely related to the ability to generate new, innovative, and adaptive ideas in addressing real-life problems (Denervaud et al., 2021).

In the context of physics education, creative thinking plays a crucial role. Physics, as a branch of natural sciences, does not only focus on the mastery of concepts, laws, and theories, but also emphasizes scientific processes such as observation, experimentation, analysis, and problem-solving. Physics learning should provide meaningful learning experiences, enabling students not only to understand concepts theoretically but also to apply them in everyday life (Astiti et al., 2024). However, in practice, physics instruction in schools still tends to be conventional and teacher-centered, providing limited opportunities for students to develop their creativity. The issue of low creative thinking skills among Indonesian students has attracted considerable attention. The results of the Programme for International Student Assessment (PISA) indicate that Indonesian students' higher-order thinking skills remain below the OECD average, particularly in problem-solving and creativity (OECD, 2023). These findings suggest that most students are still at lower

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to moderate levels of thinking, and thus have not been able to optimally develop innovative ideas. This condition is further supported by various studies showing that only a small proportion of students achieve high levels of creative thinking, while the majority fall into moderately creative or even low categories (Pajrin et al., 2024)

The low level of students' creative thinking skills is closely related to instructional practices that are still oriented toward knowledge transmission. Teachers tend to use lecture-based methods, assignments, and exercises that focus on correct or incorrect answers, thereby emphasizing convergent rather than divergent thinking (Yonanda et al., 2019). As a result, students become passive, lack confidence in expressing ideas, and are not accustomed to generating original thoughts. Observations and interviews conducted at SMAN 15 Pekanbaru revealed that students' creative thinking skills in physics learning remain low. Students tend to follow procedures provided by teachers without exploring alternative solutions and demonstrate minimal participation in classroom discussions. Creative thinking skills consist of four main aspects: fluency, flexibility, originality, and elaboration (Munandar, 2014). Students with these abilities are capable of generating numerous ideas, viewing problems from multiple perspectives, and developing solutions systematically. However, these skills do not develop automatically without appropriate stimulation. Therefore, instructional models that encourage active participation and exploration are needed. The constructivist approach is particularly relevant, as it positions students as active agents in constructing knowledge through learning experiences, thereby enhancing creativity and higher-order thinking skills (Suparlan, 2019).

One instructional model aligned with constructivist principles and with the potential to enhance creative thinking skills is the Creative Problem Solving (CPS) model. This model, developed by Osborn and Parnes, provides a systematic approach to solving problems creatively through several stages: problem clarification, idea generation, evaluation, and solution implementation (Isaksen & Treffinger, 2013). In its process, CPS integrates both divergent and convergent thinking, enabling students not only to generate multiple ideas but also to select the most appropriate solutions logically. The CPS model offers several advantages in learning. First, it increases student engagement as learners are directly involved in the problem-solving process. Second, it encourages students to think both creatively and critically in finding solutions. Third, it provides more meaningful learning experiences, as students learn through the process rather than merely focusing on final outcomes (Sanjaya, 2011). Therefore, CPS serves as an innovative instructional alternative that can be effectively applied in physics education. Previous studies have demonstrated that the CPS model is effective in improving students' creative thinking skills. Putri et al. (2019) found that the implementation of CPS improved students' creative thinking abilities from moderate to high levels. Similarly, Muriati (2022) reported significant differences between students taught using CPS and those taught through conventional methods. Furthermore, Hanifah (2023) showed that integrating CPS into STEM-based learning significantly enhances both problem-solving skills and student creativity. However, most of these studies have limitations, as they do not specifically examine the application of CPS in sound wave topics and lack comprehensive analysis of the various aspects of creative thinking. Therefore, this study offers novelty by integrating the CPS model into sound wave instruction and measuring creative thinking skills based on four main indicators in a comprehensive manner.

In addition, this study employs an experimental design that allows for a direct comparison between the effectiveness of CPS and conventional learning approaches. Thus, the findings are expected to provide strong empirical evidence regarding the impact of the CPS model on students' creative thinking skills. Based on the discussion above, it can be concluded that the low level of students' creative thinking skills in physics learning is an issue that needs to be addressed immediately. One possible solution is the implementation of the CPS learning model, which encourages students to think actively, creatively, and systematically. Therefore, this study aims to analyze the effect of applying the CPS model on students' creative thinking skills in the topic of sound waves at the senior high school level. The results of this study are expected to contribute to the development of learning theory, particularly in the field of physics education, as well as

provide practical recommendations for teachers in implementing innovative instructional models to improve the quality of learning in schools.

2. Research Methodology

2.1 Research and Design

This study employed a quasi-experimental method using a post-test only control group design. This design was selected because the researcher could not fully control external variables that may influence the learning process in a real classroom setting (Campbell & Stanley, 1963; Sugiyono, 2019).

The research design involved two groups: an experimental group, which received treatment using the Creative Problem Solving (CPS) learning model, and a control group, which was taught using conventional instruction. Both groups were administered only a post-test after the treatment to measure students' creative thinking skills. The research design is illustrated in Table 1

Table 1. Post-test Only Control Group Design

Group	Treatment	Post-test
Experimental	X	O_1
Control	–	O_2

This design allows the researcher to compare the outcomes between the two groups and determine the effectiveness of the Creative Problem Solving (CPS) model in enhancing students' creative thinking skills.

2.2 Research Location and Time

This study was conducted at SMAN 15 Pekanbaru during the second semester of the 2025/2026 academic year. The population consisted of all Grade XI students, totaling 145 students distributed across four classes. The sampling technique used was simple random sampling, ensuring that each class had an equal opportunity to be selected as a sample (Sugiyono, 2019).
Two classes were selected as research samples:

Experimental class (XI C): 38 students
Control class (XI A): 35 students

Prior to sample selection, prerequisite tests in the form of normality and homogeneity tests were conducted based on previous academic scores to ensure that both groups had comparable characteristics

2. 3 Population and Sample

This study involved two main variables, namely the independent variable and the dependent variable. The independent variable was the Creative Problem Solving (CPS) learning model, which was applied as the treatment to examine its effect on students' creative thinking skills. Meanwhile, the dependent variable was students' creative thinking skills, measured based on four main indicators: fluency (the ability to generate ideas smoothly), flexibility (the ability to think from various perspectives), originality (the uniqueness of ideas), and elaboration (the ability to develop ideas in detail).

These four indicators served as the basis for assessing students' level of creativity after participating in the learning process. The operational definitions of these variables refer to the theory of creative thinking proposed by Munandar (2014), which emphasizes that creativity is an individual's ability to produce diverse, flexible, original, and elaborated ideas in solving problems.

2.4 Research Instrument

The research instrument used in this study was an essay test consisting of eight questions designed to measure students' creative thinking skills. Each indicator of creative thinking was represented by two questions, as presented in Table 2.

Table 2. Indicators of Creative Thinking Skills

Indicator	Number of Items
Fluency	2
Flexibility	2
Originality	2
Elaboration	2
Total	8

The instrument was developed based on creative thinking indicators and was validated prior to its use. The essay format was chosen to allow students to express their ideas freely and in diverse ways.

2.5 Data Analysis Technique

Descriptive analysis was employed to describe students' creative thinking skills, including:

- Mean score
- Standard deviation
- Percentage
- Ability categories

The criteria for interpreting creative thinking skills are presented in Table 3.

Table 3. Criteria for Creative Thinking Skills

Score Interval	**Category**
3.3 – 4.0	Highly Creative
2.5 – 3.2	Creative
1.7 – 2.4	Moderately Creative
0.9 – 1.6	Less Creative
0 – 0.8	Not Creative

3. Results and Discussion

The results of the study indicate a difference in students' creative thinking skills between the experimental and control groups after the implementation of the learning treatments. The results are presented in Table 3.

Table 3. Students' Creative Thinking Skills Results

Aspect	Experimental Class	Category	Control Class	Category
Fluency	2.76	Creative	2.17	Moderately Creative
Flexibility	3.67	Highly Creative	2.64	Creative
Elaboration	2.75	Creative	2.66	Creative
Originality	2.38	Moderately Creative	1.90	Moderately Creative
Mean	2.89	Creative	2.34	Moderately Creative
Std. Dev.	0.41		0.43	

Based on descriptive analysis, the mean score of students' creative thinking skills in the experimental class was 2.89 (categorized as creative), while the control class obtained a mean score of 2.34 (categorized as moderately creative). This difference indicates that the implementation of the CPS model has a positive impact on improving students' creative thinking skills. Furthermore, the standard deviations in both groups are relatively small (0.41 in the experimental class and 0.43 in the control class), indicating that the data distribution is homogeneous and consistent.

When analyzed based on each indicator of creative thinking, the experimental class outperformed the control class across all aspects. In terms of fluency, the experimental class achieved a score of 2.76 (creative), while the control class scored 2.17 (moderately creative). In flexibility, the experimental class obtained the highest score of 3.67 (highly creative), compared to 2.64 (creative) in the control class. For elaboration, the experimental class scored 2.75 and the control class 2.66, both categorized as creative. Meanwhile, in originality, the experimental class scored 2.38, higher than the control class at 1.90, although both remained in the moderately creative category.

Table 4. Inferential Test Results

Category	Sig. (2-tailed)	Decision
Post-test scores (both groups)	< 0.05 (t = -5.129)	H_0 Rejected

The inferential analysis results indicate that the data are normally distributed and homogeneous, thus meeting the assumptions required for hypothesis testing using the Independent Samples t-test. The test results show that the significance value (Sig. 2-tailed) is less than 0.05; therefore, the alternative hypothesis (H_1) is accepted. This means that there is a statistically significant difference in creative thinking skills between students taught using the CPS model and those taught using conventional methods. Thus, it can be concluded that the CPS model is statistically proven to be effective in improving students' creative thinking skills in the topic of sound waves

Discussion

The improvement in creative thinking skills observed in the experimental class indicates that the Creative Problem Solving (CPS) model provides a more meaningful learning experience compared to conventional instruction. The CPS model positions students as active participants in the learning process and offers opportunities to explore ideas through both divergent and convergent thinking stages. This is consistent with constructivist theory, which emphasizes that knowledge is actively constructed by learners through their learning experiences (Suparlan, 2019).

Through the brainstorming stage in CPS, students are encouraged to generate multiple ideas, which significantly enhances the fluency and flexibility aspects of creative thinking. Moreover, the structured stages of CPS enable students to refine and develop their ideas systematically, thereby improving their elaboration skills. The positive contribution of the CPS model to the enhancement of students' creative thinking skills is illustrated in Figure 1.

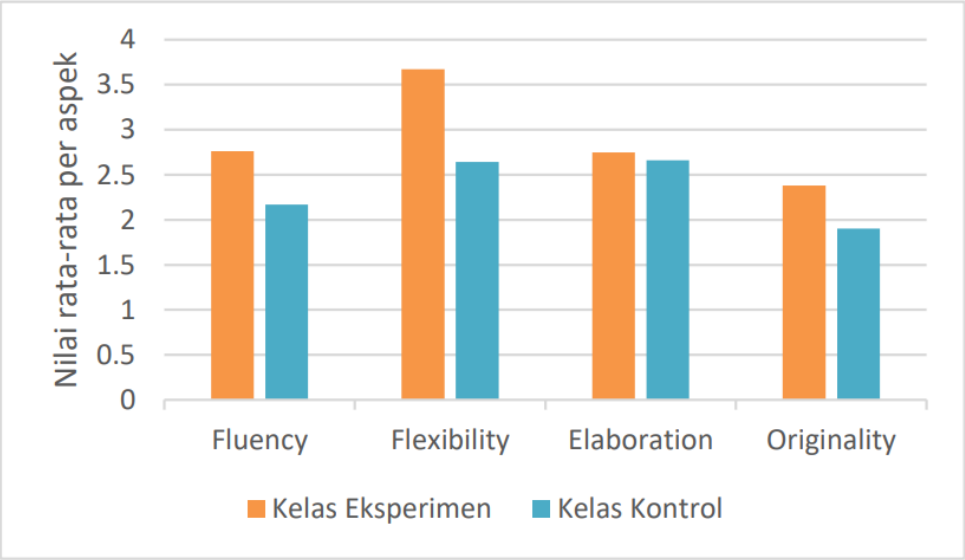

Figure 1. Mean Scores of Creative Thinking Skill Aspects

The high score in the flexibility aspect in the experimental class indicates that students were able to view problems from multiple perspectives. This occurs because, in the CPS process, students are not limited to finding a single correct answer but are encouraged to explore various alternative solutions. Group discussion activities and result presentations also provide opportunities for students to exchange ideas and enrich their perspectives. This finding is consistent with the study by Isaksen and Treffinger (2013), which states that CPS is effective in developing flexible and creative thinking skills through collaborative processes.

However, the originality aspect in both classes remains in the moderately creative category. This suggests that students still experience difficulties in generating truly novel and unique ideas. One possible reason is that students are accustomed to learning practices that are oriented toward examples provided by the teacher, leading them to imitate rather than create new ideas. This condition is also influenced by evaluation systems that emphasize correct answers rather than the creative thinking process. Therefore, instructional strategies that place greater emphasis on appreciating students' original ideas are needed. Furthermore, the results of this study indicate that the CPS model is highly effective when applied to the topic of sound waves, which is inherently abstract. Through a problem-based approach, students are able to relate sound wave concepts to real-life phenomena such as echoes, resonance, and the Doppler effect. This helps students develop a deeper understanding of concepts and enhances their elaboration skills. This finding is in line with previous studies suggesting that problem-based learning can improve both conceptual understanding and students' creativity in physics (Putri et al., 2019).

Overall, the findings of this study reinforce the conclusion that the CPS model is an effective instructional approach for enhancing students' creative thinking skills. This model not only improves learning outcomes but also fosters essential 21st-century skills required to face global challenges. Therefore, the implementation of CPS in physics learning should continue to be developed and integrated with technology and innovative learning media to achieve more optimal results

4. Kesimpulan

This study concludes that the implementation of the Creative Problem Solving (CPS) learning model has a significant positive effect on improving students' creative thinking skills in the topic of sound waves. The results indicate that students in the experimental class demonstrated higher creative thinking abilities compared to those in the control class, both overall and across each indicator, namely fluency, flexibility, elaboration, and originality. The CPS model effectively facilitates a balanced process of divergent and convergent thinking, enabling students not only to generate multiple ideas but also to systematically select the most appropriate solutions. Furthermore, the application of the CPS model to the abstract topic of sound waves proved effective in helping students relate concepts to real-life phenomena. Through structured learning stages, such as problem clarification, brainstorming, evaluation, and implementation, students became more active, independent, and directly engaged in the learning process. This contributed to improved conceptual understanding as well as the ability to develop ideas in a more detailed and meaningful manner. However, the originality aspect still requires further enhancement through instructional strategies that encourage students to confidently generate unique and innovative ideas.

The novelty of this study lies in the specific integration of the CPS model into sound wave instruction and the comprehensive measurement of creative thinking skills based on four key indicators. Practically, this study implies that teachers should adopt the CPS model as an innovative instructional alternative to enhance students' creativity and higher-order thinking skills. Future research is recommended to integrate CPS with learning technologies or STEM-based approaches to achieve more optimal outcomes.

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