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A sustainable approach to learning: Enhancing creative thinking skills through creative problem solving in green schools

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ABSTRACT

This research aims to analyse the influence of the Creative Problem-Solving learning model on the creative thinking skills of class XII high school students. This research uses a quantitative approach with a quasi-experimental design, specifically the matched only pre-test post-test control group design. The population in this study consisted of 167 students. The research sample was obtained using the cluster random sampling technique, resulting in an experimental class of 34 students and a control class of 34 students. The instruments used were tests, questionnaires, observation sheets, and documentation. The collected data was analysed using the MANOVA test. The results show that the N-Gain value for creative thinking skills in the experimental class is higher than in the control class, specifically 0.58 > 0.36. Therefore, it can be concluded that there is a significant influence of using the Creative Problem-Solving learning model on improving the creative thinking skills of class XII high school students.

INTRODUCTION

Education is one means of improving the quality of human resources. Improving this quality is an absolute prerequisite for achieving educational goals. In line with the aim of forming quality students, Senior High Schools (SMA) have the function and responsibility to carry out a good and quality educational process. Sustainable education is an approach to education that integrates the principles of sustainable development into the curriculum and school practices. The main goal is to create individuals who have a deep understanding of global environmental, social and economic challenges, and are able to take sustainable action in their daily and professional lives (Gunansyah et al., 2021; Reza, 2016; Žalėnienė & Pereira, 2021).

Sustainable education not only focuses on academic knowledge, but also develops skills, attitudes and values that support the sustainability of the planet for future generations. In practice, schools need to apply innovation and creativity in learning which can train students' skills. Creative learning is an approach to the learning process that aims to develop students' creativity through a different approach from conventional methods. Creative learning encourages students to be innovative, adaptive, and able to adapt to new challenges. This not only prepares them to solve current problems, but also to face future changes and challenges in creative and effective ways (Donoghue et al., 2021; Henriksen, et al., 2024; Kougias et al., 2022).

Environmental learning is not only important to raise awareness of today's global environmental challenges, but also to equip young people with the skills and values needed to maintain the sustainability of the planet in the future (Boca & Saraçlı, 2019). With increasing awareness, high school students often become powerful agents of change in environmental conservation efforts. They are involved in environmental projects, social campaigns, and efforts to promote more sustainable living behaviour among their peers and in the general public (Hadi et al., 2022; Pehoiu, 2019).

Green school refers to a holistic approach in managing and designing environmentally friendly learning environments. Green school is not only about physical aspects such as environmentally friendly buildings, but also involves the integration of environmental values into all school activities (Khofi, 2024). This includes the use of renewable energy, reducing waste, greening school areas, implementing an environmentally focused curriculum, and encouraging sustainable behaviour among students and teaching staff (Moreira & Rutkoskwi, 2021; Baró et al., 2021). Overall, the green school approach not only prepares students to face environmental challenges, but also builds creative thinking skills that are important in facing complex global problems in the future. By instilling sustainability values and sustainable practices from an early age, green schools provide a strong foundation for the development of the creative thinking skills needed to create sustainable solutions (Papilaya & Salhuteru, 2024).

The novelty of this research lies in its innovative integration of the Creative Problem Solving (CPS) learning model with the Green Schools concept. This approach aims not only to enhance students' creative thinking skills but also to foster environmental awareness through sustainable learning practices. By focusing on the development of creativity within an environmentally conscious school setting, this research holds the potential to make a meaningful contribution to both educational innovation and environmental conservation.

METHODS

This study employs a quantitative approach and was conducted during the odd semester in Class XII of State Senior High Schools in Bandar Lampung City. The research design used is quasi-experimental, specifically the matched-only pretest-posttest control group design. The experimental and control groups were selected using cluster random sampling techniques. Both

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groups participated in pretest and posttest assessments, with the experimental group receiving additional treatment through the implementation of the specified learning model.

In this study, the researcher had a measuring test for creative thinking skills and a self-confidence questionnaire, which in turn were supplemented by observation checklists. The four primary indicators which formed the basis of analysis of creative thinking skills included: proficient flexible thinking (which is the degree of holding many perspectives), original unique ideas generation (producing unconventional ideas), as well as fluent and elaborative thinking (capable of developing and elaborating ideas in detail).

Table 1. The matching only pretest-posttest control group design

Group	Sample	Pretest	Treatment	Posttest
Experiment	XII Science 4 (n=34)	M_1	X_1	O_2
Control	XII Science 5 (n=34)	M_1	X_2	O_2

Note: M_1 = Pretest, O_2 = Posttest, X_1 = Creative Problem-Solving model; X_2 = Discovery Learning Model

The experimental class was assigned the Creative Problem Solving (CPS) model, while the control class utilized the Discovery Learning model (Table 1). Both models were implemented over the course of three instructional meetings, each lasting one hour. The content of the lessons focused on growth and development, ensuring consistency in the material presented to both groups. By comparing the outcomes of these two teaching approaches, the research sought to determine the impact of each model on students' creative thinking skills. The stages of learning activities carried out by students in the Creative Problem-Solving model are explained in Figure 1.

Figure 1. Literature selection process using PRISMA (Wisetsat & Wisetsat, 2020)

The Creative Problem Solving (CPS) approach defines a method which uses creativity to address unique and complex critical challenges in a structured way. It involves a collection of stages aimed to take an individual or a group from the identification of a problem to the realization of effective solutions. The process starts by fact-finding, which is collecting all relevant and important data or information which provides a complete picture for informed decision making in the given context. This is accompanied by problem finding, determining the essential problem

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which is the foremost agenda in need of solutions. After defining problems, the next step involves idea finding. In this stage, all possibilities of solutions are crafted using brainstorming and other non-conventional processes. The Creatively assessed solutions are picked during the solution finding phase, which is also known as selecting the best alternative. Further in acceptance finding, greater concern is placed on potential barriers to implementation of the solution along with strategies to gain adequate support for the challenge. In implementation, the solution is executed within a controlled environment. These interconnected stages enhance flexibility coherence, creative and teamwork to approach a challenge in a way that provides real value (Gizzi et al., 2022). The syntax used in discovery learning includes stimulation, problem identification, data collection, data analysis, hypothesis testing, and drawing conclusions or generalizations.

The population in this study consisted of students. The sample was determined using the cluster random sampling technique, and the research samples were obtained from Class XII Science 4, which served as the experimental class using the Creative Problem-Solving model, and Class XII Science 5, which served as the control class using the Discovery Learning model. The posttest scores of the experimental and control classes will be compared, with the averages from each indicator being analyzed.

The data analysis technique for creative thinking skills and self-confidence questionnaires can be conducted using the following formula:

$$\text{NP} = \frac{R}{SM}\ x\ 100$$

NP is used to calculate the percentage score obtained by a student based on the raw score (R) and the maximum score (SM). This gives you a general percentage of achievement, but does not directly show improvement between pretest and posttest. The score obtained is converted into the formula Normalized Gain (N-Gain) as follows:

$$N - Gain/Normalized\ Gain = \frac{Score\ posttest - Score\ pretest}{Score\ Maximum - Score\ pretest}$$

The results of the N-Gain calculation are then converted to the classification in Table 2.

Table 2. N-Gain score criteria

Range	Category
g > 0,70	High
0,31 ≤ g ≤ 0,70	Medium
g < 0,30	Low

RESULTS AND DISCUSSION

The results of the research, which include the N-Gain data from the creative thinking skills test, can be seen in Table 3.

Table 3. Description of the N-Gain Value of the Creativity Test

Class	The number of students	*Pretest*	*Posttest*	*N-Gain*	Criteria
Experiment	34 people	44,4	80,00	0,58	Medium
Control	34 people	18,75	56,25	0,36	Medium

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Based on the data presented in Table 3, it is evident that the N-Gain value obtained by the experimental class is 0.58, which falls within the medium criteria. In contrast, the control class achieved an N-Gain value of 0.36, also within the medium criteria. In conclusion, the application of the Creative Problem-Solving model in the experimental class had a greater impact on enhancing students' creative thinking abilities compared to the Discovery Learning model used in the control class. This finding aligns with the research conducted by Masrukan et al. (2019), which states that Creative Problem-Solving learning with a contextual approach can improve students' mathematical creative thinking abilities. In this study, creative thinking skills were assessed through essay questions and vertical garden projects. The results of the creative thinking skills test, based on various indicators, can be seen in Figure 2.

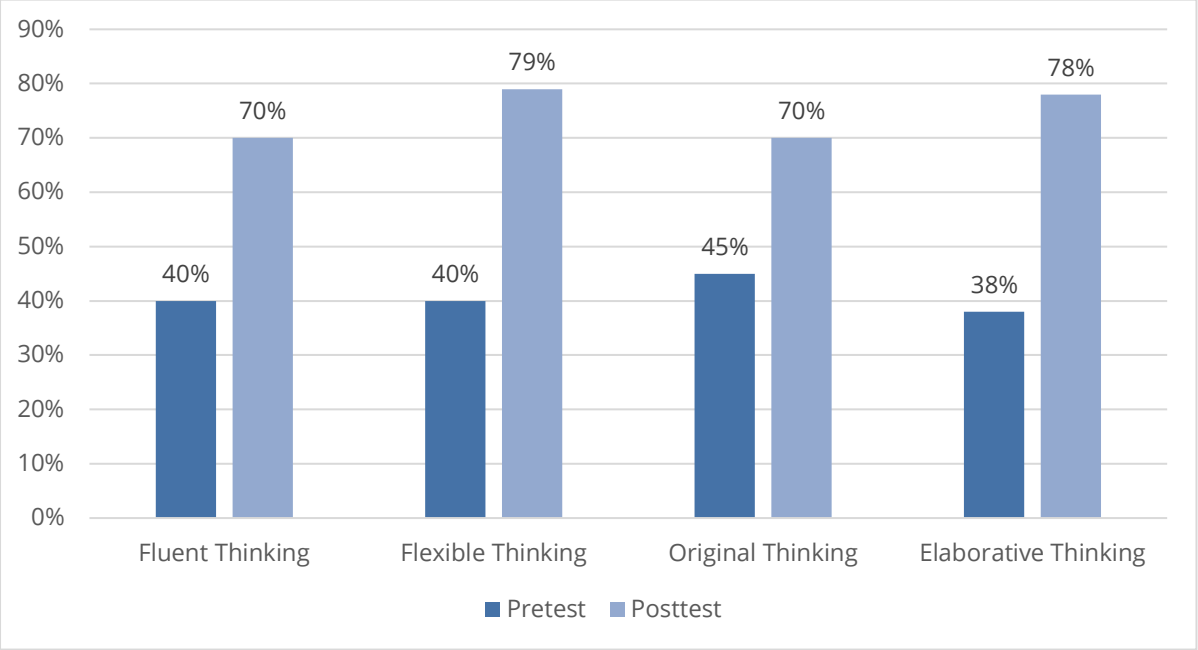

Figure 2. The results of students' creative thinking skills

An analysis of the chart reveals that the Posttest scores consistently surpass the Pretest scores across all four indicators. This indicates a notable enhancement in students' creative thinking skills following the intervention. The most substantial improvement is observed in flexible thinking, closely followed by elaborative thinking. Meanwhile, fluent thinking and original thinking exhibit nearly equivalent levels of improvement, occupying the subsequent positions. These findings suggest that the implemented strategy or program was effective in fostering the development of students' creative thinking abilities (Adam & Mujib, 2020).

The aim of this research is to examine the impact of a Green School-based Creative Problem-Solving approach on students' creative thinking abilities (Gunansyah et al., 2021). Mastery in understanding problems related to factual information is developed through creative thinking activities that emphasize fluency and flexibility (Fatmawati et al., 2022; Harms, et al. 2020). During the fact-finding stage, students are trained to identify relevant facts, thereby establishing their problem-solving frameworks. The fluency aspect is particularly nurtured at this stage, as students are encouraged to generate appropriate and relevant responses and articulate their ideas with fluency. Therefore, the Green School-based Creative Problem-Solving learning model is anticipated to enhance students' creative thinking skills, particularly in the context of understanding and solving problems (Nuswowati, et al., 2017).

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Figure 3. Students are doing a project to make a vertical garden

The Creative Problem-Solving learning model emphasizes rational and systematic approaches when resolving conflicts (Nurrijal et al., 2023). On the other hand, green schools seek to address environmental issues as a core part of their curriculum, caring for the health and wellbeing of the students and staff within the institution, as well as teaching students to be eco-friendly (Hasanova et al., 2024). In this study, the construction of a vertical garden was used as a green school project (Figure 3). This aids to further improve the students' creative thinking skills by posing a real-world problem that needs to be solved with the CPS model. Students apply fundamental facets of the creative thinking process which includes fluency, flexibility, originality, and elaboration (Runco & Alabbasi, 2024).

Green schools are principally aimed at improving the quality of education within the student's environment and reducing their carbon footprint while taking into consideration the overall well-being within the school community (Vakalis et al., 2020; Wali et al., 2017). Some of the basic characteristics of green schools are: eco-friendly buildings, environmental education, student empowerment, physical and mental health of the students, and participation from the local community. In terms of infrastructure, green schools use construction non-peat materials that are eco-friendly and sustainable. Their energy consumption is below standard as they incorporate energy-saving lights, heaters, and coolers. There is also the installation of water conserving installations like taps and the collection of rainwater. Other schools go a step further by including the use of renewable energy sources, for example solar panels and wind turbines. Green spaces in the form of gardens, yards, and outdoor learning environments aids in the support of biodiversity which acts as a perfect avenue for multi-sensory activities.

The curriculum is centered in several subjects like environmental science, biology, geography, physics, and chemistry where learners have to learn concepts like climate change, environmental stewardship, and sustainability. Environment centered activities such as field trips and observing nature add to the learning experience. Encouraging learners to take part in eco-sustainability activities like decision making enhances student participation (Ribeiro, et al. 2021).

In the objective finding stage, students are trained to think fluently, enabling them to quickly identify problems based on the given discourse. Within the creative problem-solving learning

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model, this stage focuses on exposing students to various problem formulations, enhancing their fluency in understanding problems, and encouraging the formulation of hypotheses. As a result, students' creative thinking abilities, particularly in fluency, are developed. The objective finding stage also emphasizes the importance of careful problem formulation, which is essential for fostering creative thinking skills. This process begins with the observation of factual phenomena or cases relevant to the material being studied. Once the problem is understood, students are guided in formulating the problem as a foundation for identifying potential solution steps (Van Hoojidonk et al., 2020).

In the control class, the first session began with the administration of a pretest, followed by the application of the Discovery Learning syntax, which includes stimulation, problem statement (problem identification), and group division (Costa-Silva & Lee-Schoenfeld, 2024). On December 8, 2023, during the second meeting in the experimental class, the learning process entered the problem-finding stage. At this stage, students focused on clarifying the problem by identifying the specific issue they intended to solve. The Creative Problem-Solving learning model emphasizes this stage to develop students' flexible thinking skills, encouraging them to generate alternative solutions through various approaches (Fathonah et al., 2024). Meanwhile, in the control class, the learning activities continued with the data collection and data processing stages, in which students gathered and analysed the data obtained.

At the final meeting, learning in the experimental class progressed to the idea-finding stage, where students clarified the problem by focusing on the solutions they intended to pursue (Van Hooijdonk et al., 2020). In contrast, the control class followed the stages of verification and generalization, during which students were given the opportunity to test and validate the hypotheses they had formulated, as well as to draw conclusions or generalizations to enhance future learning activities (Tipton & Olsen, 2018).

CONCLUSION

Based on the theoretical framework, supported by data analysis and aligned with the previously stated problem formulation, it can be concluded that the implementation of the Green School-based Creative Problem-Solving learning model has a positive influence on students' creative thinking skills at a high school in Bandar Lampung.

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