



The Influence of PjBSL (Project Based Scamper Learning) on Creative Thinking Skills in High School Students

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ABSTRACT

Purpose: Project Based Scamper Learning (PjBSL) is one of the alternative geography learning models, that can potentially align the independent curriculum in Indonesia aligned to the needs of 21st century skills, where critical and creative thinking skills are a priority. This study aims to determine the influence of the PjBSL learning model on creative thinking skills.

Methods: This study employed a quasi-experimental design using a pretest-posttest Project based learning model, Scamper, Creative Thinking SMA Negeri 1 Ngadiluwih. Creative thinking skills are measured using validated creative thinking instruments in the

form of 12 essay test questions which include fluency, originality, elaboration, flexibility. **Results:** Based on the t-test analysis, a significance value (2-tailed) of 0.00 (< 0.05) was obtained, which shows that there is a significant influence between the PjBSL learning model on creative thinking skills. Thus, the PjBSL learning model can improve creative thinking skills. Implications for research and **practice:** This model significantly improves students' creative thinking skills compared to conventional learning which tends to be structured, passive, and limited in the exploration of ideas. Collaboration between students, social interaction, and continuous feedback from teachers enrich the learning environment that supports optimal creativity development.

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Introduction

The ability to think creatively is one of the important skills of the 21st century that every individual must have, especially in an era full of global challenges and rapid technological developments. The education system in Indonesia is required to produce graduates who are not only academically capable, but also have critical and creative thinking skills (Kariimah et al., 2022). Studies (Fadhil, Kasli, & Halim, 2021; Putri, Riastini, & Paramita, 2022; Sukiman, Priyatni, & Suwignyo, 2023) have shown that students in Indonesia still do not have an adequate level of critical and creative thinking skills. This creates an urgency to develop a learning model that can effectively encourage student creativity. Project Based Learning (PjBL) has long been known as one of the effective models for developing critical and creative thinking skills (Bani Issa & Khataibeh, 2021; Ernst, Blood, & Beery, 2017; Kuswandi & Soepriyanto, 2021). It offers a new framework that can be the basis for further research in the field of educational innovation. This model can also be adapted at various other levels of education, including in higher education or in professional training institutions, where creativity and innovation are often the main focus. However, the application of PjBL is often limited to the academic context without a deeper exploration of the potential for developing students' creativity.

SCAMPER (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Reverse) is a creative thinking technique that helps individuals generate new ideas through modifications and combinations of existing concepts (Eberle, 1996). Several studies have shown that SCAMPER is effective in encouraging students to think out-of-the-box and improve their ability to find innovative solutions (Torrance, 1972). Although SCAMPER is widely used in the context of creative education, its integration with project-based learning models has not been explored in depth. This combination is expected to solve the problem of lack of creativity among students, because they will be encouraged to not only work on projects but also modify and create new solutions through the SCAMPER stage.

The integration between two learning models, namely Project Based Learning (PjBL) and the SCAMPER technique, has not been explored much together. Although both have been individually recognized as effective models in improving student skills, there is yet a learning model that systematically combines these two models in one structured framework. SCAMPER's incorporation in PjBL allows students to not only work based on the steps provided by the project but are also invited to think of innovative ways of solving problems through substitution, combination, adaptation, modification, elimination, and reversal of ideas. This is expected to trigger a significant improvement in the way students solve problems and create creative solutions.

The benefits of the Project Based Scamper Learning (PjBSL) model are not only limited to improving creative thinking skills, but can also strengthen other supporting skills, such as collaboration, communication, and complex problem-solving skills. PjBL has been shown to strengthen collaboration among students through teamwork in completing projects, while SCAMPER allows students to think in a more flexible and dynamic way. The integration of these two models can also help students develop divergent thinking skills, which are often considered the core of creativity (Canel, 2015). Therefore, the PjBSL model has the potential to develop students holistically, not only in

terms of academics but also in personal and social aspects. Interestingly, the application of the PjBSL model in secondary education environments, such as in high schools, also offers contextual benefits for the existing curriculum. Many educational curricula in Indonesia today still focus on cognitive aspects and material mastery (Makarim, 2022), there is an urgent need to introduce a model that is more student-centered and able to accommodate the development of higher-order thinking skills. The PjBSL model can be one solution to align the curriculum with the needs of 21st century skills, where critical and creative thinking skills are a priority. As such, this model is not only pedagogically relevant but can also be directly integrated into a variety of cross-disciplinary subjects and projects.

There is no dearth of studies to support the development of the PjBSL (Project Based Scamper Learning) model and to highlight its effectiveness in improving 21st century skills (Asyari & Andari, 2023; Bell, 2010), and to underscore the use of SCAMPER in Education (Altıparmak & Eryılmaz-Mustu, 2021; Bani Issa & Khataibeh, 2021; Moreno & Yang, 2014; Sayed & Kotb, 2020). These studies show that these two models have great potential in developing creative thinking skills. However, until now, there have not been many studies that comprehensively test the integration of the two methods in a single learning model. Previous studies have explored the individual aspects of PjBL and SCAMPER, but research examining the integration of the two is still very limited. The results of this research are expected not only to have an impact on classroom practice, but also on the development of educational policies that support creative learning models.

In addition to its pedagogical significance, this research also makes a significant contribution to the literature of creative education. The PjBSL model provides an alternative to more engaging and dynamic teaching methods, which can help improve student engagement in the learning process. Teachers not only act as facilitators, but also as guides who help students explore their creative ideas. The development of this model is also equipped with clear implementation guidelines, making it easier for educators to adopt it in various learning contexts. Thus, this research is not only relevant for improving student learning outcomes, but also supports the professional development of teachers in applying innovative and effective learning methods. Therefore, this study aims to examine the influence of the PjBSL model on the creative thinking ability of high school students.

Literature Review

The Project Based Learning (PjBL) approach has long been recognized as one of the effective learning models in supporting the mastery of 21st century skills, such as critical thinking, creativity, collaboration, and communication. PjBL allows students to be actively involved in the learning process through real projects that are relevant to their lives, thus creating a more meaningful and motivating learning atmosphere (Dias-Oliveira et al., 2024; Farhan & Ardimansyah, 2022; Wu, 2024). In PjBL, students learn concepts through the exploration of real-life projects that are relevant to their lives, which allows for the integration between theoretical knowledge and hands-on practice, thus creating more meaningful learning (Guo et al., 2020; Pramashela et al., 2023; Rehman et al., 2024; Yustina, Syafii, & Vebrianto, 2020). The advantage of PjBL lies in its

ability to help students deal with multidimensional problems through diverse problem-solving approaches. This model not only fosters students' creative thinking and initiative, but also creates a learning environment that is conducive to the development of individuality and teamwork. These skills are very relevant to the needs of modern society and are the main goal of contemporary education. However, PjBL is not free from challenges, including the role of teachers as facilitators, flexibility in implementation, cultural differences, and internal regulations of educational institutions. In addition, its success depends heavily on students' readiness in terms of knowledge, effort, perseverance, and self-regulation abilities (Pradana et al., 2024; Yoto et al., 2022; Yu, 2024; Yunus et al., 2021).

SCAMPER (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Rearrange) is a creative thinking technique introduced by Bob Eberle to help individuals systematically generate or modify ideas (Bani Issa & Khataibeh, 2021). SCAMPER is often used in educational contexts because of its simple steps and can be applied in a variety of learning situations. This technique has been shown to increase students' confidence and motivation, while encouraging the exploration of new, more creative ideas. Studies show that SCAMPER-based activities can help students maintain attention, increase learning motivation, and stimulate their creativity (Altıparmak & Eryilmaz-Mustu, 2021; Bani Issa & Khataibeh, 2021; Eberle, 1996). Studies (Fadhil et al., 2021; Putri et al., 2022; Sukiman et al., 2023) show that many students in Indonesia still do not have an adequate level of critical and creative thinking skills. Creative thinking skills are one of the main competencies in the era of the Industrial Revolution 4.0, covering four main aspects: fluency, flexibility, originality, and elaboration. Effective learning in developing these skills must encourage students to think outside the box (out-of-the-box), take intellectual risks, and come up with innovative solutions to complex challenges (Aziz et al., 2023; Purwaningsih et al., 2021; Torrance, 1972).

The merger of Project-Based Learning (PjBL) with SCAMPER, known as Project-Based Scamper Learning (PjBSL), is a learning innovation that integrates the advantages of both approaches to increase student creativity. In PjBSL, students not only design projects, but also apply SCAMPER measures to produce creative solutions to problems. Research by Wu and Wu (2020) showed that the application of PjBL combined with SCAMPER in information engineering courses, using Moodle as a learning platform, increased thinking fluency, personal motivation, and intuitive problem-solving skills, especially in students with high creativity. These students are more active in coming up with ideas, enjoy project challenges, and show a desire to improve their skills. The results of this study confirm that the integration of SCAMPER in PjBL supports the development of flexibility of thinking and authentic problem-solving skills, making it an effective approach to learning in the modern era.

Method

Research Design

The research design used was quasi-experimental because the researcher could not fully control the two groups, so the changes that occurred were not fully influenced by

the treatment. The quasi-experimental research design uses a pretest-posttest control group design. Data analysis uses an independent sample t-test with a significant level of 5% after the prerequisite test is carried out. Table 1 presents the design of Pretest-Posttest of control group.

Table 1

Design of Pretest-Posttest Control Group

Group	Pretest	Treatment	Posttest
Experiment Control	O ₁ O ₃	X -	O ₂ O ₄

Source: Campbell and Stanley (1973); Sugiyono (2011)

Description

- O1: Pre-learning test in the experimental class
- O2: Post-learning test in the experimental class
- X: PjBSL (Project Based Scamper Learning) learning in the experimental class
- O3 : Pre-learning test in the control class
- O4: Post-learning test in the control class
- : Conventional learning in the control class

Sampling

The sample of the study comprised high school students who were pursuing the independent curriculum in the 2023/2024 school year. The method of determining subjects of the study was carried out by purposive sampling, namely subjects were selected based on almost the same characteristics of cognitive abilities as reflected in odd midterm exam (UTS) scores for the 2023/2024 academic year. Based on the average data of UTS scores, class XI.7 was determined as the experimental class and class XI.8 as the control class. The implementation of the learning model carried out in the two classes was different. The experimental class was carried out with the PjBSL model, while the control class was taught with a conventional model by giving assignments.

Creative Thinking Assessment Instrument

The magnitude of students' creative thinking ability is obtained from the results of the analysis of students' answers to the description questions. The students' answers were examined and analyzed based on the assessment rubric. Each description question was analyzed from the four indicators of creative thinking, namely fluency, flexibility, originality, and elaboration. Each of these indicators had a maximum score of four, so that in one question, the maximum score that students can have been 4. If there are 12 questions each with a maximum score of 4, the entire question has a maximum score of 48. The scoring criteria for the students' creative thinking ability test were assessed using a modified creative thinking rubric from (Treffinger, Young, & Selby, 2002). Table 2 presents creative thinking skills rubric.

Table 2

Assessment Criteria for Creative Thinking Ability Test Answers

Indicator	Criteria	Value
Fluency	Mentioning/writing 4 or more different ideas, suggestions or alternative answers	4
	Mentioning/writing 3 different ideas, suggestions or alternative answers	3
	Mentioning/writing several ideas, suggestions or alternative answers that are not too different	2
	Mentioning/writing one idea, suggestion or alternative answer	1
	No answer or wrong answer	0
Originality	Mentioning/writing some unique ideas that are interesting and logical, relatively new and relevant to the given problem	4
	Mentioning/writing some unique ideas that are interesting logically, relatively new but less relevant to the given problem	3
	Mentioning/writing ideas that are quite unique, interesting, and logical and relevant to the given problem	2
	Mentioning/writing ideas that are ordinary, logical and relevant to the given problem	1
	No answer or wrong answer	0
Elaboration	Explaining some logical details on an existing idea so that the idea formulation becomes easier to apply and clearer	4
	Explaining one logical detail on an existing idea so that the idea formulation becomes easier to apply and clearer	3
	Providing some logical details on an existing idea but not in accordance with the concept of the idea so that it cannot be used to clarify the idea	2
	Not adding details to an existing idea so that the idea formulation is less applicable	1
	No answer or wrong answer	0
Flexibility	Writing several alternative answers that are very logical and relevant to the problem given from various different perspectives	4
	Writing several alternative answers that are quite logical and relevant to the problem given from various different perspectives	3
	Writing several alternative answers that are quite logical but less relevant to the problem given from various different perspectives	2
	Writing one alternative answer that is quite logical and relevant to the problem given from only one perspective	1
	No answer or wrong answer	0

Source: adapted from [Treffinger et al. \(2002\)](#)

From the score obtained, the score was then made into a value in the form of a percentage of students' abilities based on the four indicators of creative thinking ability. The calculation of the percentage score of students can be found by using the following formula.

$$NP = \frac{R}{SM} \times 100$$

Where:

NP: Percentage of creative thinking ability

R: score obtained by students for each

SM indicator: maximum score that can be obtained by students

The amount of percentage obtained by each student was then classified based on the assessment category according to Sugiyono (2011) as seen in the Table 3.

Table 3

Scale of Creative Thinking Ability Category

Value (%)	Category
86 - 100	Very Good
71 - 85	Good
56 - 70	Sufficient
41 - 45	Less
≤ 40	Very Less

Data Analysis

Statistical analysis in this study used an independent sample t-test. This analysis was used to find out the difference in the use of the PJS� model that had an effect on the improvement of students' creative thinking from the experimental group and the control group. The decision making in the independent sample t-test was based on hypothesis testing on the score of data acquisition of creative thinking ability. The hypothesis testing in this study is as follows.

H₀: *The PjBSL learning model has no effect on students' creative thinking.*

H_a: *The PjBSL learning model has an effect on students' creative thinking.*

The decision-making criteria in the t-test were by comparing the probability value (p-value) of the t-test to the level of significance $\alpha = 5\%$. If the probability value is $\geq \alpha$ then H₀ is accepted and H_a is rejected, but if the probability value is $< \alpha$ then H₀ is rejected and H_a is accepted. All statistical data analysis in this study uses the help of IBM SPSS 23.0 for Windows program. This is intended in addition to making it easier to calculate and also get accurate analysis results. The level of significance used in this study is 5%

Results

Results of Quasi Experiment

The instrument for assessing creative thinking ability before being used for data collection was tested for validity first. This validity test of the instrument was made by comparing the value of the calculation at a significance level of 5%. If the r count $>$ rtable, the instrument is declared valid, but if the r count $<$ rtable, the instrument is declared invalid (Sugiyono, 2011). The results of the validity test of the creative thinking ability instrument in 32 students in this study were declared valid. The recapitulation of the validity test results is shown in Table 4.

Table 4

Results of the Validity Test of Creative Thinking Instruments

Item	R Count	R Table	Description
P1	0,611	0,361	Valid
P2a	0,720	0,361	Valid
P2b	0,848	0,361	Valid
P2c	0,636	0,361	Valid
P3	0,604	0,361	Valid
P4a	0,659	0,361	Valid
P4b	0,699	0,361	Valid
P5	0,815	0,361	Valid
P6a	0,618	0,361	Valid
P6b	0,816	0,361	Valid
P7	0,767	0,361	Valid
P8	0,552	0,361	Valid

Based on the validity test of the creative thinking ability instrument as mentioned in Table 4, the results of the loading factor value of all items were above the r table (0.361). Therefore, it is concluded that all statement items are valid for use. The instrument in this study was declared reliable if the reliability coefficient of Cronbach's alpha is more than 0.60. The results of the reliability test of the creative thinking ability instrument in 32 students in this study were declared reliable. Specifically, the results of the reliability test are shown in the following Table 5. Table 5 presents the reliability test results.

Table 5

Reliability Test Results

Variable	Cronbach Alpha	Description
PjBSL	0,897	Reliable

Based on the reliability test, the results of the Cronbach alpha value of all variables are above 0.6. Therefore, it is concluded that all variables are reliable to be used.

Description statistics

The Quasi-experimental research produces data from bound variables in the form of Mean and standard deviation. Data were obtained from the experimental class with treatment using the PjBSL model and the control class with conventional learning treatment. The data description of each bound variable is as follows.

Creative Thinking Ability

Students' creative thinking ability is described from the results of pretests and posttests. A summary of the description of creative thinking skills which includes average, minimum score, standard deviation is presented in Table 6.

Table 6

Data on Creative Thinking Ability

Group	Description	N	Mean	Minimum	Maximum	Standard Deviation
Experiment	Pretest	32	71,5495	64,58	79,17	4.08555
	Posttest	32	89,8438	79,17	97,92	4,05599
	Gain	32	18,2943	14,59	18,75	
Control	Pretest	32	71,5495	58.33	79.17	5.25475
	Posttest	32	77,2135	68.75	85.42	5.34269
	Gain	32	5,664	10,42	6,25	

Table 6 shows that the average pre-rated value of the experimental class is 71.54, the same as that of the control class, which is 71.54. The average score of the experimental class of 89.8438 was greater than that of the control class of 77.21. Furthermore, the average value of the increase (gain) of the experimental class, which is 18.29, is greater than the control class of 77.21. The conclusion based on the data is that 1) creative thinking ability in both class groups has increased and 2) the increase in creative thinking ability in the experimental class is greater than that of the control class, with a difference of 12.63.

Results of the Hypothesis

Test of the Influence of the PjBSL Model on Creative Thinking Ability

The data analysis of the results of the experimental research aims to test the influence of the PjBSL model on creative thinking skills. The calculation of the analysis prerequisite test in this study includes normality and homogeneity tests. The two prerequisite tests were carried out on the increase (gain) data scores of the experimental and control classes. Meanwhile, to determine whether the data is normally distributed or not, it is necessary to conduct a normality test. The researcher used Shapiro Wilk with SPSS type 26 because the sample used was 32. Meanwhile, if the samples used are more than 50, Kolmogrog Smirnov is used for normality tests. The data can be said to be normal if the data value is more than 0.05. On the other hand, if the test result is less than 0.05, the data is not normal.

Table 7

Normality Test

	Tests of Normality		
	Statistic	df	Sig.
Pre-Test Control	.954	32	.190
Pre-Test Experiment	.945	32	.105
Post-Test Control	.918	32	.092
Post-Test Experiment	.936	32	.057

Table 7 presents the results of the normality test, the significance value (sig) of the pretest scores of the control class, pretest of the experimental class, post-test of the control class and post-test of the experimental class was greater than 0.05, therefore the decision to accept H0 was obtained with the conclusion that the scores of the pretest of the control

class, pretest of the experimental class, post-test of the control class and post-test of the experimental class were normally distributed.

Furthermore, the homogeneity test of creative thinking ability data used the Levene test. Specifically, a summary of the results of the homogeneity test of creative thinking ability data is shown in Table 8.

Table 8

Homogeneity Test

		Independent Samples Test	
		Levene's Test for Equality of Variances	
		F	Sig.
Creative Thinking Ability	Equal variances assumed	6.358	.014
	Equal variances not assumed		

In the homogeneity test (Table 8), a significance value based on mean of 0.014 was obtained which was smaller than 0.05; therefore, a decision to reject H0 was obtained with the conclusion that the variation in the score of creative thinking ability in the control class and the experimental class was not homogeneous. The results of the homogeneity test in the experimental and control classes obtained significance values of $p (0.014) < \alpha (0.05)$. Based on this significance value, it can be concluded that the data on the creative thinking ability of the experimental and control classes are different (not homogeneous).

Hypothesis testing was carried out by independent sample t-test (equal variances not assumed). This is based on the fact that the data on creative thinking skills are normally distributed and have different variants (not homogeneous). The results of the t-test of creative thinking ability data are specifically shown in Table 9.

Table 9

Results of Independent Sample Test (Equal Variances Not Assumed)

		Independent Samples Test						
		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper	
Creative Thinking Ability	Equal variances assumed	-10.651	62	.000	-12.63021	1.18579	-15.00058	-10.25984
	Equal variances not assumed	-10.651	57.823	.000	-12.63021	1.18579	-15.00399	-10.25643

In Table 8 of the hypothesis test above, a significance value of 0.000 was obtained which was smaller than 0.05, therefore a decision to reject H0 was obtained with the conclusion

that there was a significant average difference between the scores of students' creative thinking ability in the control class and the experimental class. This means that the application of the Project Based Scamper Learning (PjBSL) learning model is able to improve students' creative thinking skills.

Discussion

The Effect of the PjBSL Model on Creative Thinking Ability

The learning model is used in the teaching and learning process for students to achieve the expected goals (Pramashela et al., 2023). In line with this, this study uses Project Based Scamper Learning, the results of the study show that there is an influence of the learning model on students' creative thinking skills. The PjBSL learning model has a better influence on students' creative thinking skills. Students who get PjBSL learning get higher creative thinking skills scores than conventional class students. The PjBSL model contributes to improving students' creative thinking skills. The results of this study corroborate previous research that the combination of PjBL and Scamper improves students' creative thinking skills in Engineering courses (Wu & Wu, 2020). In project-based learning, students' creative thinking skills are developed from the beginning to the end. Indicators of creative thinking skills are used during the learning process which include: fluency (the ability to generate a large number of ideas), flexibility (the ability to suggest different solutions to a problem), originality (the ability to generate original new ideas), and elaboration (the ability to organize various ideas into a single product or a more complete solution) (Treffinger et al., 2002).

In classes that apply conventional learning, the improvement of students' creative thinking skills is lower than that of PjBSL. This is because not all students actively participate in learning. The role of teachers in conventional classroom learning is still large. Learning activities through discussions and assignments do not provide students with opportunities to explore, create new ideas, and opportunities to make works (products) are also still limited so that students' creative thinking skills are less developed. In contrast to PjBSL classroom learning, students get a wide opportunity to generate ideas, make several alternative solutions to solve problems, and innovate to create project products. As stated (Guo et al., 2020), Project-based learning facilitates students to build their knowledge (constructivists), while conventional classroom learning of teachers as masters dominates learning. Constructivism in project-based learning makes students have better creative thinking skills.

This is in line with previous research that project-based hybrid learning using animated videos has an effect on creative thinking skills. The skill acquisition of the experimental class was greater than that of the control class and this difference was statistically significant (Nurwahyuni et al., 2022). In line with research on junior high school students in grade VIII on vibration and wave material. The results of data analysis showed that the PjBL learning model could increase the CTS of students in the experimental class with a higher category compared to the control class. Student learning outcomes through the PjBL learning model show better than through non-PjBL. The PjBL model can improve students' creative thinking skills and learning outcomes (Fadhil et al., 2021).



Figure 1: The Stages of Implementing the PjBSL Model.

PjBSL class learning begins with asking essential questions. At this stage, students begin by observing their surroundings to identify relevant phenomena or problems. The first observation was made online in the classroom to find real issues that could be used as a basis for formulating essential questions. After making observations, students are invited to think critically and creatively to formulate essential questions that will be the focus of the project. This question should be relevant, challenging, and spark further exploration. These essential questions should also be related to the learning objectives and be able to direct students to find solutions. Based on the observations and information obtained, students make inferences or preliminary conjectures about potential causes or solutions to the observed phenomenon or problem. Students then use the theory or concept they have learned as a basis for thinking to

formulate essential questions. This theory helps them relate the observed problems to academic concepts, so that the questions asked are more structured and meaningful (Bell, 2010; Kokotsaki, Menzies, & Wiggins, 2016). By asking essential questions, students are directed to have a clear view of what they want to learn and achieve through the project, as well as how the project can help them find answers to the questions they are asking (Abas et al., 2024; Buroidah, Zubaidah, & Mahanal, 2023).

The second stage is designing a project plan. After asking essential questions in the previous stage, students are directed to identify the main problem they will solve through the project. This involves group discussions to agree on the main focus of the project. Students begin to design a research framework based on the theories they have learned. This includes the preparation of research objectives, problem formulation, and research steps to be carried out. Students are encouraged to think creatively and design innovative solutions and solve complex problems (Bell, 2010; Blumenfeld et al., 1991). The activity of developing a project plan trains students to generate a large number of ideas, as well as develop the ability to solve problems with a variety of different solutions (Wibowo et al., 2024). The heterogeneity of group members affects the improvement of creative thinking skills. Students who are raised and educated in different environments will acquire different knowledge, cognitive processes, and value systems. Therefore, in the activity of designing a project plan, it is likely to produce diverse and innovative ideas. When individuals in a group face problems, their cognitive diversity can provide an opportunity to look at problems from a new perspective to create unique concepts and designs (Rahmawati & Wolo, 2022; Ramdani & Susilo, 2022).

Students evaluate various research methods that they can use to collect data. These methods can be surveys, experiments, interviews, observations that are appropriate to the context of the project. Teachers guide students in choosing the method that best suits their essential questions and project goals. Students divide the assignment among group members, determining who is responsible for each part of the project. This includes responsibility for research, data collection, analysis, and reporting. Teachers provide feedback on the project plan prepared by students, helping them identify potential problems or areas that need improvement. By completing this stage, students not only have a structured and in-depth plan for their project, but have also developed critical thinking skills, creative thinking, and research abilities that will be useful in later stages (Krajcik & Blumenfeld, 2005). The problems chosen by each group are different, so students can learn from the experiences of other groups and gain a wider range of knowledge (Widodo et al., 2023). After they make a project plan, the Scamper's steps are applied to improve the prototype/plan of the project that has been made.

In the third stage, students rearrange or refine their prototypes/project plans using SCAMPER to come up with more creative and effective solutions. The first step of such an initiative is to substitute or replace the supporting components. Students begin by identifying components and materials in their project that can be replaced with better or more efficient alternatives. They can replace the materials used in the project design with materials that are more environmentally friendly or cheaper. In this activity, the teacher helps students explore various alternatives, leading them to consider the impact of each change on the overall project. In the substitution step, students are encouraged to identify

and replace the project components with better alternatives, so that they not only think conventionally, but also creatively look for more innovative solutions (Eberle, 1996). By changing the materials or components used, students are trained to think critically and creatively in considering the effectiveness and efficiency of their projects. They need to evaluate various alternatives in terms of sustainability, cost, and impact on the environment. In this context, creative thinking arises when students question whether there are materials that can be replaced with more environmentally friendly or cheaper ones, as well as how such substitutions can improve project outcomes. This process facilitates divergent thinking skills, which allow students to generate many alternatives, and think evaluatively, as they assess the impact of those changes on the goals and quality of the project (Michalko, 2010). This stage strengthens creative skills, such as flexibility (in considering various possibilities), originality (in finding new solutions), and elaboration (in developing more detailed and useful solutions) (Robinson, 2002).

The second step is to combine or combine ideas. In this process students look for ways to combine their ideas or project elements with other relevant ideas. This could involve merging two features of different products into one or integrating additional technologies to improve the functionality of the prototype/project plan. Through this process, students are encouraged to create new solutions that may not have been imagined before, by combining existing elements. The combination process requires students to combine ideas or elements that were previously separate into a new and more effective solution. In this context, students integrate various ideas or elements of the project, such as features of two different products or technologies, so as to be able to create superior innovations. Creative thinking is involved here in several ways, namely flexibility in thinking. Students should be able to see the connections between various ideas or elements that seemed unrelated before. They need to consider new ways of combining different elements, which requires flexibility in thinking to break out of conventional mindsets. The incorporation of different elements results in new ideas that have never existed before. When students combine two different things, they create unique and innovative solutions that enhance the functionality of their projects, reflecting their original, creative thinking abilities (Haryanto et al., 2024; Michalko, 2010). This combination step improves students' ability to think synthetically, i.e. the ability to combine different ideas into a more innovative unit.

The third step is to adapt or adjust the product. Students customize their products to better suit the needs of users or specific conditions. For example, they can adapt a project plan, can work better in a particular environment, or cater to the needs of users for different needs. In this activity, teachers encourage students to consider how their products can be more flexible and adaptive in various situations. Product adaptation or adjustment activities are closely related to the ability to think creatively. Students are required to tailor their products to better suit the needs of specific users or conditions, reflecting flexibility in thinking (Runco & Pritzker, 2011). This ability allows students to think openly and change their initial plans according to the situation at hand. In addition, by encouraging students to consider how their products can be more flexible and adaptive, they are encouraged to demonstrate originality in developing new solutions that have not been thought of before. The adaptation process also requires students to come up with ideas about how the product can work in various situations, which shows fluency in thinking. Furthermore, students need to expand and elaborate product details to suit diverse needs, demonstrating

elaboration skills in creative thinking. Overall, this statement emphasizes the importance of creative thinking by developing flexibility, originality, fluency, and elaboration in the product customization process (Treffinger, Isaksen, & Stead-Dorval, 2000).

The fourth step is to modify or change the product. Students identify specific parts of the prototype that can be modified to improve performance or efficiency. These modifications can be changed in the design, size, shape, or function of the product. The statement about modifying products is closely related to the development of creative thinking skills, especially in terms of flexibility and elaboration. Students who are asked to identify specific parts of a prototype that can be modified practice the ability to think flexibly, where they have to consider different ways to change the design, size, shape, or function of the product. This flexibility demonstrates the ability of students to think outside the framework of their initial ideas and look for new, more effective solutions. In addition, the modification process involves elaboration, where students develop and deepen modification details to ensure improved performance or efficiency of the product. Students also practice originality, as every change they make is the result of creative and innovative thinking, looking for new, untried ways to optimize products. Overall, this modification step encourages students to think creatively by exploring and implementing new ideas in an effort to improve the quality of their products (Amabile, 1983; Runco & Jaeger, 2012).

The fifth step is put to another use. At this stage students explore how the components of their prototype can be used for other purposes or in different contexts. Parts of the product that were originally designed for one purpose can be changed to serve another useful function. For example, leachate left over from composting teak leaves can become pesticides. At this stage, teachers help students see the potential of their product as a solution to more than one problem, encouraging them to think multi-functionally. Students are asked to explore how components from their prototype can be utilized for other purposes or in different contexts. This activity encourages flexibility of thinking, where students are challenged to view product components not only in their initial function, but also as solutions that have the potential to solve other problems (Csikszentmihalyi, 2014). Originality is also involved when students find new and innovative ways to utilize parts of a product that are designed for one purpose, but can be altered to serve other useful functions (Zhou & George, 2001). For example, leachate from the composting of teak leaves that was originally waste can be turned into pesticides, demonstrating the ability to change the perspective of a product and find creative new uses. In addition, this stage involves divergent thinking, where students need to think of a variety of other possible uses for their product, beyond its original function (Amabile, 1983; Runco, 2008). With the help of teachers who encourage students to see the potential of the product as a solution to more than one problem, they are strengthened to think multi-functionally and innovatively.

The sixth step is elimination. Students assess elements of their product that may not be essential or overly complex. They decide to eliminate those elements or simplify them to make the product more efficient or easy to use. In this activity, the teacher directs students to focus on the core of their project, eliminating elements that do not provide significant added value. The elimination step in this activity is closely related to the development of students' creative thinking skills. As students assess the elements of the product they create, they are challenged to identify which are essential and which can be removed without

compromising the project's core value. This process requires critical thinking skills, deep analysis, and the courage to make informed decisions. By simplifying elements that are too complex or do not provide significant added value, students not only improve product efficiency, but also practice the ability to think flexibly and innovatively (Amabile, 1983; Runco, 2008).

The seventh step is to reverse or reset the product. Students evaluate their overall project by considering how their product can be reorganized or deconstructed to produce better results. Students can try reversing the order of the process or changing the direction of the design. In this step the teacher supports students in experimenting with redesign ideas, giving them the freedom to find solutions that may be unconventional but effective. The reverse step in this activity is very related to the development of students' creative thinking skills. In this stage, students are invited to evaluate and reflect on their project, testing how rearranging product elements can lead to better results (Runco & Jaeger, 2012). By reversing the order of the process or overhauling the design, students practice thinking in a non-linear and exploratory way, which is a hallmark of creative thinking. This is in line with (Sternberg, 2006) discusses the "triarchic theory" of creativity which emphasizes that creative thinking involves the ability to flexibly redesign problems and solutions. The freedom that teachers give to experiment with unconventional ideas encourages students to explore new possibilities and find innovative solutions (Amabile, 1998). Through this step, students not only learn about flexibility in thinking, but also develop the skills to overcome challenges with different and creative models. The reverse step involves transformational creativity, where students remodel something that already exists into a new form by twisting or deconstructing the design (Boden, 2003).

In the Scamper stage, it was found that students were better able to understand the concept of creativity, they were able to design surprising project plans through creative thinking with the Scamper stage. According to our findings, the characteristic of creative thinking, namely originality, increases significantly and consistently. In the process, students apply various possibilities while being processed and adjusted to the situation and conditions of their home region, namely Kediri. The ability of students to process waste into fertilizer and develop packaging using burlap material as biodegradable or environmentally friendly packaging that suits the situation and conditions is a creative act because what they develop describes originality. However, originality is not always considered a creative act if it is not effective or useful, feasible, appropriate or appropriate for purpose or appropriate (Runco & Jaeger, 2012). It was also found that in experiments conducted in groups, students who had closed personalities were unable to participate in discussions well. Therefore, experiments are needed for project activities that are carried out individually to see the effectiveness of creative thinking from "Scamper".

In the fourth stage, namely compiling a project work schedule, students are encouraged to think metacognitively, namely by planning, organizing, and monitoring their project tasks in order to achieve the expected goals. The elaboration of this stage activity begins with students breaking down their project into smaller, more specific steps or tasks. Each step needs to be clearly identified to ensure that all aspects of the project are addressed thoroughly. After identifying the project steps, students develop a realistic schedule for each step. They set deadlines for each task and ensure that the sequence of activities is

logical and manageable. Compiling a detailed project work schedule is an important step that not only improves project management skills, but also supports the development of students' creative thinking skills (Dietrich et al., 2010). By managing time, resources, and monitoring progress, students learn to think systematically and flexibly in dealing with various challenges that arise during the project process (Mumford & Gustafson, 1988). They are required to plan model steps, adapt to changes, and explore alternative solutions in case of obstacles. This ability trains students to think creatively in a structured way, where they need to combine analytical and exploratory thinking in achieving optimal results (Turner & Müller, 2005). The time and resource management skills developed from this scheduling also prepare students for future projects, where innovation and efficiency will be key to success.

The fifth stage is to monitor students and project progress. At this stage, students continue the investigation and investigation activities that have been planned in the previous stage. They collect empirical data relevant to the problem they are solving in the project. Students document the data collected systematically, either through field notes, photos and videos. This documentation is important to facilitate data analysis and report preparation later. During and after data collection, students use their imagination to develop new ideas or alternative models that they may not have considered before. This creativity helps in finding more effective and innovative solutions. Since this stage requires monitoring students, the progress of this project is crucial to ensure that students stay on track in the investigation process. This structured model not only helps students in organizing their thinking, but also opens up space for the development of creativity and innovative solutions. Teachers play an active role in providing constructive guidance and feedback, as well as providing opportunities for further consultation, which helps students overcome any challenges they may face during the project (Bell, 2010). At this stage, creative thinking skills are applied. Students formulate the stages of project work, choose the right method, compile instruments, and continue with investigation activities. Project work monitoring activities provide students with the opportunity to report on the progress of their projects. The project work report is given feedback by the teacher. Students also make works (products) from the results of the project. Product creation makes students have to think creatively and constructively. This is in line with the fact that in project activities, students become creative and constructive through various projects, as well as make works from their project assignments.

The sixth stage is the assessment of results. At this stage, students present the results of their project work in the form of artifacts, which are the final product of the project they are working on. This stage encourages students to use their imagination and creativity to the fullest in producing valuable works. Students use their imagination to design artifacts that are not only functional but also visually appealing. In making compost, students develop new methods or additional materials that improve the quality of fertilizer. Creativity in choosing materials or manufacturing techniques is the key to producing better products. Students prepare a presentation where they demonstrate the products they have made. They explain the manufacturing process, the challenges they faced, and how they applied the Scamper technique in their projects. For products such as compost, students may demonstrate how to use them and explain their benefits. They can also show the results of the use of the product, for example, the effect of fertilizer on plant growth.

Teachers assess products based on predetermined criteria, such as creativity, innovation, effectiveness, and suitability with project goals. This assessment also includes an evaluation of the students' thought processes and how they overcome challenges during the project. Other students provide feedback on the artifacts presented, which helps to improve the final result. This process also trains students to give and receive constructive criticism (Larmer & Mergendoller, 2010; Thornhill-Miller & Dupont, 2016). Students document the entire compost manufacturing process, including challenges, solutions, and deliverables. This documentation is in the form of written reports and videos. The resulting video is published on their social media accounts. This provides an opportunity for students to showcase their work to a wider audience.

Finally, teachers conduct an overall assessment of the project, considering all aspects from the process to the final result. This includes an evaluation of students' abilities in critical thinking, creativity, teamwork, and project management. Teachers provide constructive and specific feedback that can help students in future projects. The focus is on continuous skill development and improvement of the quality of work (Holm, 2011). This stage is very important because it marks the culmination of all the efforts students put in during the project. The presentation of artifacts not only shows the end result of their hard work, but also illustrates their ability to apply the knowledge and skills they have learned. The assessment provides a clear picture of the project's success and areas that can still be improved (Barron & Darling-Hammond, 2008).

The seventh stage is experience-evaluation. Students are directed to reflect and organize the knowledge they have gained during the project into more in-depth and meaningful concepts. They also recap the important concepts that have been learned to strengthen their understanding and make the knowledge more meaningful and applicable. Students recap the important concepts that are at the heart of their project. This can be the theory underlying the project, the methods used, or the important findings resulting from the research or investigation conducted. Students not only summarize, but also analyze how the concepts relate to each other and how their understanding of the material has evolved over the course of the project. They also think about the practical applications of these concepts in a broader context.

Students integrate the new knowledge they have acquired with the knowledge they already possessed. This process helps students form a more holistic and contextual understanding. Students use critical and creative thinking to evaluate the relevance and validity of the knowledge they have learned. They consider how this knowledge can be applied outside of the project, as well as how it enriches their overall understanding. Students formulate a follow-up plan based on what they have learned. This could include ideas for future projects, applications of newly acquired knowledge, or improvements that need to be made in their learning model.

The PjBSL model has several advantages, namely, (1) Learning becomes more flexible and creative because there are revision stages in improving the project product design. (2) The PjBSL model not only focuses on project work activities but also emphasizes the important aspects in project design, project implementation and student understanding in learning activities. (3) Develop creative thinking skills. SCAMPER encourages students to think outside the conventional boundaries through the steps of its activities, helping

students generate new and innovative ideas in solving the problems of the projects they are working on. (4) Contextual and relevant learning. PjBSL focuses on projects that relate to the real world, thus making learning more relevant and meaningful. When SCAMPER is implemented, students are also invited to think about how the project they are working on can be more relevant to the real context, or even find new ways to use it. (5) Improve problem-solving skills. The process in PjBSL requires students to confront problems head-on, identify solutions, and explore various alternatives through SCAMPER. It develops more creative and innovative problem-solving skills. (6) Integrating collaborative learning. PjBSL emphasizes teamwork, where students learn to share ideas, discuss solutions, and work toward a common goal. The implementation of SCAMPER enriches the dynamics of group work by providing space for various views in designing, adapting, and developing projects. (7) Encourage student independence and responsibility. In PjBSL, students take full responsibility for the projects they work on. They must plan, manage, and evaluate projects independently, which encourages learning independence and time management. (8) Increase motivation to learn. Projects in PjBSL often relate to real life and students' interests, and involving creative elements through SCAMPER, students become more motivated and enthusiastic to engage in learning. They feel more engaged because they play an active role in their own learning. (9) Develop communication and presentation skills. Students must present the results of their project at the end of the process. The use of SCAMPER can provide an additional framework for structuring their ideas in an interesting and innovative way, thus further honing their communication skills. (10) Encourage emotional engagement and experiential learning. PjBSL fosters deeper emotional engagement as students feel directly involved in the creative and problem-solving process. They experience firsthand the learning process and the results of the projects they complete.

Conclusion

The results of this study show that the Project-Based Learning model combined with SCAMPER (PjBSL) significantly improves the creative thinking ability of high school students. The average creative thinking ability of students in the experimental class (using the PjBSL model) was higher than in the control class (using the conventional model). This is due to the unique characteristics of the PjBSL model that directly encourages divergent thinking, allowing students to generate new ideas, consider various alternatives, and find innovative solutions. Collaboration between students, dynamic social interaction, and continuous feedback from teachers also enrich the learning environment that supports the development of creativity. Thus, this model has proven to be more effective than conventional learning methods which tend to be more structured and limited.

This research has several limitations. First, the sample size was small, as it was derived from only one high school, namely SMAN 1 Ngadiluwih, Kediri Regency, and which was carried out only within one semester on Environmental material. The number of samples is limited to two classes at SMAN 1 Ngadiluwih, Kediri Regency, so the results cannot be generalized widely. In addition, the research was carried out within one semester and was limited to Environmental material, so its impact on other topics or curriculum could not be known. Based on these results and limitations, it is recommended that the PjBSL model be more widely integrated into the learning curriculum, especially in subjects that require the

development of student creativity. The development of a PjBSL-based learning module that includes detailed steps, project examples, and assessment rubrics is also needed to support the implementation of this model. Further research is suggested to include a wider student population, other learning topics, and longer implementation durations to evaluate the long-term impact of this model on creative thinking abilities.

The application of the model is broader and more sustainable, considering the results of research to strengthen teacher competence in implementing PjBSL. The implementation of PjBSL requires teachers' skills in designing relevant projects, managing time, and providing constructive feedback. Therefore, it is highly recommended to organize training and workshops for teachers to improve their competence in using this model. Teachers also need to continue to be supported in integrating SCAMPER's creative thinking stages effectively in the learning process so that students can get the maximum benefit from this model. For further researchers, it is also recommended to provide adequate resources, such as digital learning media, relevant project materials, and access to supporting technologies. The use of technology, such as learning videos and interactive apps, can enrich students' learning experience as well as strengthen their engagement in projects. The development of PjBSL-based modules accompanied by SCAMPER guidance can also be a model step in supporting the implementation of this model. It is recommended that the PjBSL model be adapted to the conditions of the learning environment in various schools, both in urban and rural areas. This adaptation can be in the form of project adjustments to be more relevant to the local context and resources available in the school. For schools with limited access to technology, the use of environment-based projects or local resources can be an effective alternative. It is recommended to conduct further research with a wider population and over a longer period of time. This follow-up research could include an evaluation of the impact of PjBSL on other aspects such as learning motivation, communication skills, and students' problem-solving skills. Additionally, it is important to explore the application of PjBSL to various subjects to see the extent to which this method can have a positive impact in various learning contexts.

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