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PROBLEM-BASED LEARNING MODELS: THEIR EFFECTIVENESS IN IMPROVING CREATIVE THINKING SKILLS OF STUDENTS WITH DIFFERENT ACADEMIC SKILLS IN SCIENCE LEARNING

S. Suciati*[1], S. Silvita[2], O. Prasetyo[3], M. D. Fauziah[4], K. D. Santika[5], A. M. Norawi[6], H. T. Rahman[7]

[1,4,5]Department of Science Education, Universitas Sebelas Maret, Indonesia
[2,3]Department of Biology Education, Universitas Sebelas Maret, Indonesia
[6]School of Educational Studies, Universiti Sains Malaysia, Malaysia
[7]Department of Life Science, National Central University, Taiwan

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ABSTRACT

This study aims to 1) test the effectiveness of using simple and complex problem-based learning models in improving students' creative thinking skills and 2) test the effectiveness of simple and complex problem-based learning models in improving students' creative thinking skills based on different academic skills. This research was quasi-experimental with a pre-test-post-test non-equivalent control group design involving 96 students in grade VII taken by cluster random sampling including a control class with a simple problem-solving model (SPS), experimental class 1 using the Creative Problem Solving (CPS) learning model, and experimental class 2 using the IDEAL-Problem solving (IPS) learning model. The hypothesis test used the N-Gain Score and ANCOVA. The results reveal that the simple problem-based learning model, namely SPS, is less effective in improving students' creative thinking skills. While complex problem-based learning models, namely CPS and IPS, are effective enough to improve students' creative thinking skills. Both simple and complex problem-based learning models can improve the creative thinking skills of students with different academic skills. Based on the results, it can be concluded that the most effective model for improving the creative thinking skills of students with different academic skills is the CPS learning model.

Keywords: academic skills; creative thinking; problem-based learning

INTRODUCTION

The rapid development of science and technology and globalization characterize the 21st Century. This greatly impacts all aspects of life, including education. The field of education is required to produce highly competitive human resources and solve life problems, including 4C skills, namely critical and problem-solving, creativity, collaboration, and communication (Carlgren, 2013; Kim et al., 2019). The 21st-century problems are increasingly diverse and complex, requiring solutions that are not simple but require integrated cross-fields of science. The National Science Teacher Association (NSTA) explicitly emphasizes that students must be equipped to communicate and think creatively through the problem-solving process. Students must be equipped with creative skills to express their ideas to solve problems (Munandar, 2012; Zhou et al., 2020).

In fact, students' problem-solving skills are still not optimal (Husamah et al., 2018). This is reflected in the achievement of PISA (Programme for International Student Assessment) test results that examine scientific literacy through

***Correspondence Address**
E-mail: suciatisudarisman@staff.uns.ac.id

problem-solving questions, showing that a trend of problem-solving achievements tends to be low. The PISA test, which investigates problem-solving skills, can be one of the benchmarks for students' achievements in solving problems for students from various parts of the world. Based on data from the Organization for Economic Co-operation and Development/OECD (2022), the achievement of Indonesian students shows relatively low results. Indonesia is ranked 62nd out of 70 (2015), 72nd out of 78 participating countries (2018), and 62nd out of 71 participating countries (2021). Problem-solving skills seem closely related to students' creative thinking skills.

The importance of creative thinking skills to face the era of Industrial Revolution 4.0 and Society 5.0 is inevitable. These skills are essential for students to develop new ideas, improve efficiency, and design solutions to complex problems related to science content. In addition, these skills are the basis for innovating and preparing excellent human resources. Thus, creative thinking skills have an essential role to be empowered in the student learning process (Selfa-Sastre et al., 2022; Karunarathne & Calma, 2023)

Creative thinking is necessary when someone faces a problem to find a solution. This aligns with the results of research by Bolandifar and Noordin (2013), showing that thinking creatively is an essential capital in problem-solving. According to Munandar (2012), creative thinking is characterized by a person's ability to develop something new and find problem-solving solutions. Creative thinking indicators include 1) fluency, which is the ability to come up with many ideas that are relevant to thinking patterns fluently; 2) flexibility, namely the ability to form a mindset in terms of various aspects; 3) originality, namely the ability to build ideas that are new and unique originally; 4) elaboration, namely the ability to explain various ideas in detail in solving a problem (Guilford, 1995; Treffinger, 1995).

According to the test results for creative thinking skills in scientific classes, the fluency aspect is 47.5%, flexibility is 28.9%, originality is 21.24%, and elaboration is 30.8%. These results suggest students' creative thinking skills are still rated as moderate or low. Results of this study do not support the expectations of the 21st century, which call for students to be innovative thinkers. Various previous research results also indicate that many students have limited creative thinking skills (Rahayu et al., 2022; Botagariyev et al., 2023)

Based on observations and teacher interviews in 12 schools, it was discovered that the answers provided by students to the questions were confined to those copied from the book. This is also compounded by the teacher's assignments, which only require students to answer questions in the book, preventing students from thinking creatively. Additionally, students are not given questions in the form of problems, preventing students from solving specific problems. The learning model is also limited to lectures, resulting in knowledge transfer between teachers and students without the opportunity for students to think at a higher level.

Thus, there is a gap between ideal conditions and reality in science education. The main issue causing the gap between ideal conditions and realities is that the class's teaching and learning process has not promoted students' creative problem-solving. As a result, it is vital to use a learning model that can promote problem-solving skills and their impact on students' creative thinking skills. Previous research has shown that problem-based learning approaches can help students develop creative thinking skills (Nuswowati et al., 2017; Rahayu et al., 2022).

Creative thinking can be evaluated using tests that characterize the flow of creative thinking (Munandar, 2012; Rubenstein et al., 2019). Students can be trained to think creatively by introducing them to a challenge and requiring them to solve it. Thus, teaching students problem-solving skills is an excellent strategy to hone their creativity and equip them to compete in the global market (Oppenheimer et al., 2017). According to the qualities and nature of learning, science should be taught to foster higher-order thinking skills through problem-solving. Meanwhile, science education in schools does not promote optimal problem-solving. Learning still manages to be teacher-centred with conventional methods, so it has not trained problem-solving skills optimally. Learning is only a knowledge transfer and has not been optimal in training creative thinking (Kurdi, 2009).

Training students' creative thinking skills can be done by applying problem-solving-based science learning models. This is relevant to the mandate of the 2013 Curriculum on process standards that learning (especially science) is oriented to models of discriminatory learning, inquiry, problem-based learning, and project-based learning. Science learning models based on problem-solving, such as problem-based learning, creative problem-solving, problem posing, IDEAL-problem solving, real-world problem-solving, and many others, have been widely developed and researched.

Several research have been undertaken to assess how problem-based learning models affect students' creative thinking skills (Maskur et al., 2013; Ulger, 2018; Kardoyo et al., 2020). However, no one has compared the effectiveness of using problem-based learning models to improve students' creative thinking skills with other academic skills, although academic skills are closely related to students' creative thinking skills (Tran et al., 2022). This study includes students with varying academic skills in order to demonstrate that the problem-based learning model used has the same effect on the creative thinking skills of students with low, medium, and high academic skills. Furthermore, no studies have been undertaken to examine the effectiveness of the three types of problem-based learning models, namely simple problem-solving (SPS), creative problem-solving (CPS), and IDEAL problem-solving (IPS), and their effects on students' creative thinking skills. As a result, this study is important to determine the impact of using simple problem-solving models (SPS), creative problem-solving (CPS), and IDEAL problem-solving (IPS) on students' creative thinking skills. Table 1 shows a comparison of syntaxes for each model.

Table 1. Comparison of SPS, CPS, and IPS Learning Model Syntaxes

	SPS (Polya, 1973)	CPS (Treffinger, 1995)	IPS (Bransford & Stein, 1993)
1	Understand the problem	Find mess	Identify problem
2	Devise a plan	Find data	Define goal
3	Carry out the plan	Find problems	Explore possible strategies
4	Look back	Find idea	Anticipate the outcome and act
5		Find solution	Look back and learn
6		Find acceptance	

Creative Problem-solving (CPS) is a problem-based learning model that emphasizes developing divergent thinking skills through problem-solving activities (Rubenstein et al., 2019). The CPS learning model also facilitates students to actively solve problems by creating creative ideas using reasoning and building knowledge through experience so that students can find problem-solving solutions in different ways (Hobri et al., 2020). The CPS learning model has six syntaxes, including 1) mess finding, which is finding problems from the cases presented; 2) data finding, which is collecting data related to the problems presented; 3) problem finding, formulating problems based on the data collected; 4) idea finding, reviewing, grouping, and expressing various ideas related to problems; 5) solution finding, refining and reinforcing ideas to be chosen as a problem-solving solution; 6) acceptance finding, describing the idea of a specific problem-solving solution (Treffinger, 1995). The advantage of the CPS learning model is problem-solving using scientific methods so that students can investigate, analyze, and evaluate problem-solving solutions to encourage students to think (Kim et al., 2019). This is supported by various research results showing that the CPS learning model positively impacts students' positive thinking skills (Mayasari et al., 2013; Abdulla & Cramond, 2018; Kim et al., 2022).

While the IDEAL-Problem-Solving learning model has five syntaxes including: 1) Identify problem; 2) Define goal; 3) Explore possible strategies (explore and develop various possible problem-solving strategies that can be used); 4) Anticipate outcomes and act; 5) Look back and learn (review the problem-solving process that has been done) (Bransford & Stein, 1993). The results show that this model positively improves creative thinking skills (Elfiani, 2018; Sari et al., 2021).

Creative thinking is closely related to higher-order thinking skills, especially critical thinking (Kim et al., 2019). In learning activities (Science), a person's academic skill is a picture of the ability to think, including creative thinking, especially in issuing new ideas that are different in the problem-solving process (Mönkediek & Diewald, 2022). Academic skills can be categorized into three groups, namely high, medium, and low academic skills (Camiel et al., 2017; Mönkediek & Diewald, 2022). Thus, applying learning models to students with different academic skills is predicted to have different results. In light of the aforementioned issues, the purpose of this study is to 1) assess the effectiveness of using simple and complex problem-based learning models in improving students' creative thinking skills; and 2) investigate the effectiveness of simple and complex problem-based models in improving students' creative thinking skills based on various academic skills.

METHODS

This research was quasi-experimental with a pre-test-post-test non-equivalent control group design (Ary et al., 2010) with the following design in Table 2.

Table 2. Research Design

Group	Pre-test	Treatment	Post-test
Control	O_1	X_1	O_2
Experiment 1	O_1	X_2	O_2
Experiment 2	O_1	X_3	O_2

Note:
O_1 = Pre-test scores
X_1 = The Class with Application of Simple Problem Solving (SPS) learning model
X_2 = The Class with Application of Creative Problem-Solving (CPS) learning model
X_3 = The Class with Application of IDEAL- Problem-Solving (IPS) learning model
O_2 = Post-test scores

The sample used by 96 grade VII students in Solo Regency taken by cluster random sampling included three classes, namely: one class with a simple problem-solving learning model (SPS), one class using the Creative Problem-Solving (CPS) learning model, and one class using the IDEAL-Problem-Solving (IPS) learning model.

This study used research techniques, both tests and non-tests. The non-test techniques used observation of the science learning process and documentation. While the test technique consisted of 16 essay questions with question indicators referring to indicator creative thinking skills, according to Treffinger (1995), including 1) fluency, 2) flexibility, 3) originality, and 4) elaboration. The distribution of questions as a test instrument according to the indicators of creative thinking skills is presented in Table 3.

Table 3. The Distribution of Questions Items to Measure Creative Thinking Skills

Indicators of Creative Thinking Skills (Guilford, 1995; Treffinger, 1995)	Description	Questions Number
Fluency	The ability to come up with many ideas that are relevant to thinking patterns fluently.	1, 2, 3, 12
Flexibility	The ability to form a mindset in terms of various aspects.	5, 7, 8, 13
Originality	The ability to build ideas that are new and unique originally.	6, 10, 11, 14
Elaboration	The ability to explain various ideas in detail in solving a problem.	4, 9, 15, 16

The test instrument used had been validated through content and construct validation. A reliability test was also conducted using Cronbach's Alpha with a value of 0.797 so that the data was declared high reliability. The question items used in the study were 6.25% questions in the easy category, 87.5% in the medium category, and 6.25% in the difficult category.

Students' academic skills were measured using students' creative thinking scores using the following categories in Table 4.

Table 4. Students' Academic Skill Categories (Arikunto, 2019)

Categories	Score
Low	$X < M - SD$
Medium	$M - SD < X \leq M + SD$
High	$X > M + SD$

Note:
X = Creative Thinking Skills Scores
M = Mean of Creative Thinking Scores
SD = Standard Deviation

Data were analyzed using the N-Gain Score and ANCOVA. The N-Gain Score value categories can be seen in Table 5.

Table 5. N-Gain Score's Categories (Arikunto, 2019)

Percentage (%)	Interpretation
< 40	Ineffective
40 – 55	Less Effective
56 - 75	Effective Enough
>76	Effective

In addition to using the N-Gain Score, the ANCOVA test was also conducted with the prerequisite test, namely the normality test with Kolmogorov Smirnov and the homogeneity test with the Levene test with the help of SPSS version 22.

RESULTS AND DISCUSSION

Students' creative thinking skills are influenced by various factors, including academic skills and the learning environment (Tran et al., 2022). This research was conducted by applying three forms of problem-based learning models, namely simple problem-solving (SPS) and complex problem-solving, namely creative problem-solving (CPS) and IDEAL problem-solving (IPS). The impact of applying these three models as a form of setting the learning environment on students' creative thinking skills on different academic skills is measured to determine the most effective problem-solving-based learning model. The effectiveness of SPS, CPS, and IPS learning models in improving students' creative thinking skills can be seen from the N-Gain value contained in Table 6.

Table 6. Comparison of the Effectiveness of SPS, CPS, and IPS Learning Models based on N-Gain Scores

No.	Category	Model SPS	Model CPS	Model IPS
1.	Ineffective	9	1	4
2.	Less Effective	11	4	5
3.	Effective Enough	11	13	20
4	Effective	1	14	3
	Number of samples	32	32	32
	N-Gain Score	46 %	71%	60%

Table 6 shows the average N-Gain Scores for the three learning models. The class with the SPS learning model obtained the lowest average N-Gain (46%). The class getting treatment with the CPS learning model has the highest average N-Gain (71%) in the criteria of being effective enough. In contrast, the class getting treatment with the IPS learning model has an average N-Gain score of 60% (quite effective). This shows that providing a specific problem-based learning model is better than a simple one. However, the CPS learning model is more effective than the IPS learning model in improving students' creative thinking skills.

To see the significance of the effectiveness of the influence of SPS, CPS, and IPS learning models on students' creative thinking skills, statistical tests were carried out, starting with the normality test and homogeneity test as prerequisites. The normality test performed on students' pre-test and post-test scores can be seen in Table 7.

Table 7. The Result of the Normality Test

Test	Types of Learning Models	Kolmogorov-Smirnov Sig.
Pre-test	SPS	.200*
	CPS	.200*
	IPS	.126
Post-test	SPS	.120
	CPS	.063
	IPS	.115

Table 7 shows the normality test results of the pre-test and post-test scores of students' creative thinking skills in the three research groups. The normality test stipulates that the sample is normally distributed if the significance value is more significant than 0.05 (Kim & Park, 2019). The analysis results show that the significance value is more significant than 0.05. This means that the samples used in this study are normally distributed. Next is the homogeneity test presented in Table 8.

Table 8. The Result of the Homogeneity Test

F	db1	db2	Sig.
1.262	2	93	.288

Table 8 presents the analysis of the pre-test and post-test scores of students' creative thinking skills in the three research groups. The analysis results show that all three research groups have significance values greater than 0.05. Thus, the results of the homogeneity test show that the sample used in the study has a homogeneous variance. Because the results of the normality test and homogeneity test as prerequisite tests show that the sample is normally distributed and the variance is homogeneous, the sample can be further tested using the ANCOVA parametric statistical test (Kozak & Piepho, 2018), as presented in Table 9.

Table 9. The Result of the ANCOVA Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1314.476[a]	3	438.159	12.035	.000
Intercept	42410.171	1	42410.171	1164.863	.000
Pretest	4.726	1	4.726	.130	.719
Types	1290.939	2	645.469	17.729	.000
Error	3349.524	92	36.408		
Total	630638.000	96			
Corrected Total	4664.000	95			

Table 9 reveals that the significance value of the variable influence of the type of treatment on the post-test is 0.000 (0.000 < 0.05). Test results affect the type of treatment by eliminating the effect of the pre-test (covariate) on the post-test. Thus, it means that there is a difference in post-test scores between the type of treatment with the control class (SPS learning model) and experimental class 1 (CPS learning model), and experimental class 2 (IPS learning model). Furthermore, the mean value of the post-test value can be calculated by applying the three models as presented in Table 10.

Table 10. The Difference of Mean Value in Implementing SPS, CPS, and IPS Learning Models

Types	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
SPS	75.835[a]	1.072	73.705	77.965
CPS	84.893[a]	1.090	82.729	87.056
IPS	81.522[a]	1.072	79.393	83.652

Table 10 shows the calculation of the mean values in the three classes by providing SPS, CPS, and IPS learning models. The mean score in the class with the CPS learning model shows the highest score (84.893). Meanwhile, the class with the IPS learning model got a medium score (81.522). Then, the class with the SPS learning model get the lowest score (75.835). Furthermore, the Least Significant Difference (LSD) test is carried out as presented in Table 11.

Table 11. The Test on the Difference Between Implementation of SPS, CPS, and IPS Learning Models

Types of Treatments	Types of Treatments	Sig.[b]
SPS	CPS	.000
	IPS	.000
CPS	SPS	.000
	IPS	.032
IPS	SPS	.000
	CPS	.032

The data in Table 11 are the results of LSD follow-up tests. LSD test results show that each treatment given to all three study classes has a significance value smaller than 0.05. Thus, it can be interpreted that each treatment has a noticeable difference. The class with the SPS learning model is significantly different from the classes with the CPS learning model and the IPS learning model. The class with the CPS learning model also has real differences from classes with IPS and SPS learning models. The class applying the IPS learning model also has real differences from classes with the SPS and CPS learning models.

The implementation of the SPS, CPS, and IPS models to improve students' creative thinking skills is also reviewed based on their academic skills. Students' academic skills based on test results in this study are grouped into three categories: low, medium, and high. The pre-test and post-test results describe the profile of students' academic skills before and after receiving treatment, as shown in Figure 1.

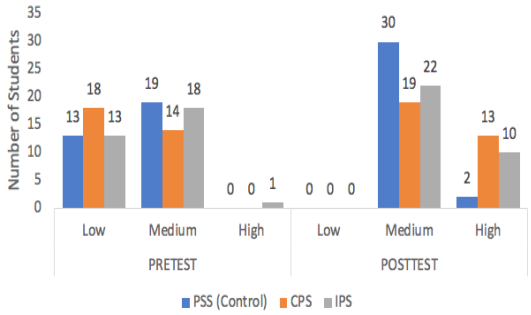

Figure 1. Categories of Students' Academic Skills Based on Scores of Creative Thinking Test

Figure 1 shows the data from the pre-test analysis of students on their creative thinking skills. Indicators of creative thinking skills used in the test questions include fluency, flexibility, originality, and elaboration. In the control class with the SPS learning model, most students are in the low category (13) and medium category (19). In experimental class 1 using the CPS learning model, most students' creative thinking skills are in the low category (18) and medium category (14). While in experimental class 2 using the IPS learning model, the majority of students' creative thinking skills are in the low category (13), medium category (18), and high category (1). This indicates that most students in the three classes have an initial academic skill background in the low and medium categories.

The results of post-test data analysis show differences in students' academic skills based on their creative thinking skill test scores after being given treatment. The control class with the SPS learning model shows an increase in their creative thinking skills. There is a change in the category of creative thinking skills, where students who are in the category of academic skills are increasing in number (30), and students with high academic categories are increasing (2). In experimental class 1 with the CPS learning model, there is also an increase in students' creative thinking skills. Students with medium academic skills are increasing (19), and students with high academic skills are increasing (13). Similarly, there is a change in experimental class 2 with the IPS learning model. Students with medium academic skills increase (22), and high academic skills increase (10). This shows that problem-solving-based learning models can generally improve students' creative thinking skills, where classes initially dominated by students with low and medium academic skill categories shift to be dominated by students with medium and high academic skills.

Academic skill can be interpreted as student achievement in mastering knowledge and skills related to the context studies. The pre-test results show that the initial academic skills of students are in the low and medium categories (Figure 1). Initial academic skills are specific knowledge and skills students have mastered (Siburian et al., 2019). This initial academic skill is very important as a basis for constructing new knowledge (Chen et al., 2021; Spoon et al., 2021). Based on the post-test results, treatment by applying problem-based learning models with different types can improve students' academic skills (Figure 2). This is relevant to the research results that show that students' academic skills are closely related to creative thinking skills.

Students' creative thinking skills play an essential role in determining the success of student learning (Mumford & McIntosh, 2017; Siburian et al., 2019; Nouri et al., 2020). The CPS learning model is the most effective model based on research results to improve students' creative thinking skills. CPS is a learning model that creatively solves problems (Al-Zahrani, 2015; Gholami et al., 2016).

Creative thinking skills are interrelated with academic skills and learning environments, such as the learning model applied (Tran et al., 2022). The results show that applying simple problem-based learning models (SPS) and complex problem-based learning models, namely CPS and IPS, can improve students' creative thinking skills in students with low to medium academic skills and those with medium to high academic skills. However, the CPS learning model is the most effective in empowering students' creative thinking skills.

CPS syntax (mess finding, data finding, problem finding, idea finding, solution finding, and acceptance finding) has characteristics that can encourage indicators of creative thinking skills, including fluency, flexibility, originality, and elaboration (Lewis et al., 2018). When students can solve problems and provide ideas and answers to the problem-solving that will be given, it will encourage student fluency in finding solutions to student problems (fluency). When students can generate varied ideas and solve problems from different points of view, it increases student flexibility (Harris & de Bruin, 2018). When students can come up with new ideas for solving problems, it will increase the indicator of student originality (Raiman et al., 2017; Harris & de Bruin, 2018). In the last syntax, students must explain problem-solving results in detail (Lewis et al., 2018). This syntax can push toward the indicator of student elaboration (Yusnaeni et al., 2017).

Each CPS model syntax contains activities encouraging students to bring out their ideas and creativity in problem-solving actively. This is relevant to Bruner's learning theory, which states that learning is a process that involves students actively finding new things in problem-solving (Takaya, 2008). In addition, in complex problem-solving models (CPS and IPS), students are required to analyze problems by discussing with their groups which are essentially a zone of proximal development, to encourage students to exceed their abilities or be in the zone of actual development (Berkhout et al., 2018; Wang, 2019). This is relevant to Vygotsky's theory of learning (Harland, 2003; Loftus & Higgs, 2005; Lawal et al., 2021). Thus, the use of complex problem-solving models (CPS or IPS) occurs in the process of developing creative thinking skills in students. The syntax of the four CPS (idea finding) models seems to have more significant opportunities for students to develop new ideas than the social studies model. The potential of CPS syntax in empowering students' thinking skills is visualized in Figure 2.

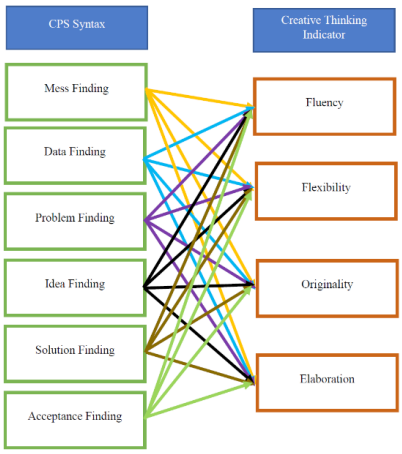

Figure 2. The Potential of CPS Syntax to Empower Students' Creative Thinking Skills

First, in the syntax of mess finding, students are required to find new ideas based on observations to solve problems (Mejía-Villa et al., 2023). They also present the experiment's results smoothly in front of the class (Park & Jeon, 2022). This activity follows Dewey's theory that learning is a process of reconstructing experience that adds meaning to experience to solve problems. Students' learning experience at this stage will impact the improvement of their creative thinking skills, namely fluency, flexibility, originality, and elaboration (Karunarathne & Calma, 2023).

Second, in the data finding syntax, students are required to express the observation data obtained through group discussions and accept ideas from various points of view (Van Hooijdonk et al., 2023). This learning activity will encourage students to think creatively and discover new things (Kartikasari et al., 2022). This activity is relevant to Brunner's theory, which states that learning is an active process that involves students in the discovery process. This activity will train each indicator of students' creative thinking skills (Karunarathne & Calma, 2023).

Third, in the syntax of problem finding, students are required to formulate problems from observations that are viewed from various points of view so that students can provide temporary answers or varied hypotheses (Park & Jeon, 2022). This activity is also relevant to Brunner's theory, which states that learning is an active process involving students discovering new things and solving problems. Thus, learning activities at this stage can also improve students' creative thinking skills (Saeed & Ramdane, 2022).

Fourth, in the syntax of idea finding, students are required to analyze and detail new ideas obtained to solve problems through experiments with group members (Anggara et al., 2023). According to Vygotsky's learning theory of social interaction, if students can work together in groups, they are already in the zone of proximal development. Furthermore, in the solution-finding syntax, students are required to process and analyze the result data in detail and conclude the experiment results with group members. According to Vygotsky's learning theory of social interaction, students who can formulate problems and determine answers to these problems are in the zone of potential development. This group activity will stimulate students' creative thinking skills.

Finally, in the acceptance finding syntax, students must give the results of the experiment smoothly and in detail in front of the class and group members. The set of exercises encourages students to describe the results of problem-solving and then draw inferences from the experiments (Tran et al., 2022). According to Vygotsky's theory, this learning activity demonstrates that students are in the potential and proximal development zone. This allows students to actively work on their creative thinking skills (Hsia et al., 2021).

Several prior studies have found that problem-based learning models can boost students' creative thinking skills (Maskur et al., 2013; Nuswowati et al., 2017; Kardoyo et al., 2020; Ulger, 2018; Wu & Wu, 2020). However, in this study, three types of problem-solving-based learning models have been demonstrated to be effective in improving students' creative thinking skills.

Using three types of problem-based learning models (SPS, CPS, and IPS) has various effects on students' creative thinking skills. However, when compared to the IPS and SPS models, the CPS model is the most successful at improving students' creative thinking skills (Table 4). The high effectiveness of the CPS learning syntax is demonstrated by its strong potential to encourage students' creative thinking by providing learning experiences for students to practice various indicators of creative thinking skills such as fluency, flexibility, originality, and elaboration, as illustrated in Figure 2 (Ulger, 2018; Cancer et al., 2023).

CONCLUSION

Based on the study's results, we may conclude that: 1) SPS, a simple problem-based learning model, is less effective in increasing students' creative thinking skills. While complex problem-based learning models, namely CPS and IPS, are effective in boosting students' creative thinking skills. 2) Both simple and complex problem-based learning models can help students with a variety of academic skills enhance their creative thinking skills. The CPS learning model is the most successful technique for enhancing students' creative thinking skills across academic skills.

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