

APPLICATION OF PROBLEM POSING LEARNING MODEL TO IMPROVE STUDENTS' CREATIVE THINKING SKILLS IN THE TOPIC OF CHEMICAL EQUILIBRIUM IN GRADE XI

Alvin Maghfirah and Rusmini*

Department of Chemistry, FMNS, Universitas Negeri Surabaya

e-mail: rusmini@unesa.ac.id

Abstract

Previous research has shown that the problem posing learning model is effective in improving students' creative thinking skills. However, research on the application of the problem posing learning model to the topic of chemical equilibrium which simultaneously studies the implementation of this learning model, student activities, creative thinking skills, learning outcomes, and student responses remains limited. Therefore, this research aims to describe the implementation of the problem posing learning model, student activities, students' creative thinking skills, student learning outcomes, and students' responses to the implementation of the problem posing learning model on the topic of chemical equilibrium. The research design used was a single-group pretest-posttest design in classes XI-1 and XI-2 at Mambaul Ulum 2 Private Madrasah Aliyah in Ponjatan Timur, Baturammar, Pamekasan. The results of the study indicate that the implementation of the problem posing learning model on the topic of chemical equilibrium received an overall rating of "very good," with average implementation rates of 91.30% and 100% for classes XI-1 and XI-2 during the first meeting and 100% for both classes during the second meeting. Observations of student activities supported the implementation of the problem posing learning model, with an average of 100% (very good category) in every meeting for both Class XI-1 and XI-2. Students' creative thinking skills improved based on the Paired Samples t-test, which showed a value (2-tailed Sig.) of 0.000 in both Class XI-1 and XI-2 and was supported by N-gain scores in the range of $0.3 \leq g \leq 0.7$ (medium category). Student learning outcomes improved, with a classical completeness rate of 85% in Class XI-1 and 80% in Class XI-2. The student feedback questionnaire revealed positive responses, with an average percentage of 94.44% in Class XI-1 and 89.72% in Class XI-2. This indicates that problem posing learning model is effective in improving creative thinking skills in the topic of chemical equilibrium.

Keywords: problem posing, creative thinking skills, chemical equilibrium

INTRODUCTION

The 21st century marks a new chapter in the history of human civilization. A defining feature of this century is the industrial revolution, which is gradually transforming the world into a more open and globalized era. Human life in the 21st century is undergoing a transformation that requires high-caliber individuals in every aspect of life, including in the field of education. Education in the era of globalization is marked by rapid advances in science and technology, which demand that students possess the skills to face increasingly intense competition and the challenges of the times.

Students in 21st-century must be able to develop competitive skills relevant to 21st-Century Skills [1]. The Partnership for 21st Century Skills defines 21st-century skills as the 4Cs: critical thinking and problem-solving, communication, collaboration, and creativity and innovation [2]. This means that in the 21st century, education focuses not only on increasing knowledge but also on developing students' thinking skills, one of which is creative thinking.

Creative thinking skills are one of the four core competencies that students must possess. The importance of creative thinking skills in learning is also one of the missions of the Merdeka Curriculum, which is currently being implemented

in Indonesia. The Merdeka Curriculum is designed to meet educational demands by integrating 21st-century skills into learning. Through the Merdeka Curriculum, students are prepared to become competent, principled lifelong learners who behave in accordance with the values of Pancasila as embodied in the Pancasila Student Profile [3]. Creativity, as one of the dimensions of the Pancasila Student Profile, is greatly influenced by creative thinking skills [4]. Therefore, creative thinking skills need to be cultivated and incorporated into various subjects.

Chemistry, as one of the required subjects in the national curriculum, is a subject that can be used to foster creative thinking. Chemistry lessons often present problems with a variety of solutions. Students' ability to propose diverse solutions to chemistry problems is the primary objective of instruction that emphasizes student creativity [5].

One of the topics covered in chemistry is chemical equilibrium. Chemical equilibrium is a topic that provides students with the opportunity to develop creative thinking skills. Creative thinking involves seeking various answers based on the information provided, with a focus on the diversity of answers and their relevance to the context [6]. In learning about Chemical Equilibrium, students are encouraged to understand how changes in factors such as concentration, pressure, temperature, or the addition of a catalyst can affect the equilibrium position. By analyzing various possible changes, students can consider different scenarios and predict their impact on the reaction system. This process helps students not only to find a single correct solution but also to consider various alternatives consistent with the principles of chemical equilibrium. Therefore, the topic of chemical equilibrium can be used as a means to develop creative thinking skills.

However, in reality, there are still many obstacles to developing creative thinking skills. Several studies indicate that creative thinking skills are not optimally developed through formal education [7]. Other research also reveals that creative thinking receives insufficient attention in education and that students' creative thinking skills have not yet fully developed [8]. This is also

supported by the results of a pre-research at Mambaul Ulum 2 Private Madrasah Aliyah in Ponjanaan Timur, Batumarmar, Pamekasan, which showed that creative thinking skills across all indicators were still relatively low: fluency at 38%; flexibility at 27%; originality at 5%; and elaboration at 10%.

The students' lack of creative thinking skills is due to the fact that school instruction generally does not provide students with the opportunity to develop their thinking skills independently. Chemistry instruction in schools still employs conventional teaching methods, in which learning remains teacher-centered [9]. Similarly, the results of pre-research interviews indicated that instruction at MAS Mambaul Ulum 2 in Ponjanaan Timur, Batumarmar, Pamekasan has predominantly relied on the lecture method. This is because students tend not to understand the material unless it is explained in detail. This method results in passive classroom learning, as students are not at the center of the learning process, and the teaching-learning process in the classroom becomes monotonous. This is what causes students' creative thinking skills to be stunted and underdeveloped. Passive learning, such as students being fixated on material or concepts found in textbooks and the opinions of others, as well as a lack of confidence in their own opinions can hinder students' creative thinking abilities [10]. Another factor is the lack of application of problem-solving concepts to address challenges in learning and in daily life [11]. The learning process in school also places greater emphasis on unproductive thinking, focuses on rote memorization, and seeks a single "correct" answer to the questions posed. In chemistry classes at school, teachers more often assign routine questions, such as multiple-choice and essay questions, rather than problems that require problem-solving, resulting in students' creativity remaining relatively low [9]. Similarly, interviews conducted with chemistry teacher during the pre-research revealed that the questions given are usually routine and do not differ significantly from sample questions. Consequently, classroom

instruction does not train students to think creatively.

To address these issues, chemistry instruction must encourage students to optimize their creative thinking skills. Creative thinking skills can be developed during the learning process by presenting problems for students to solve, thereby allowing them to explore ideas for solving the given problems [12]. To this end, teachers must employ appropriate instructional models. One such model that can be used to enhance creative thinking skills is the Problem Posing instructional model.

The problem posing learning model involves presenting a problem by asking students to formulate questions based on the information provided [13]. Students are not only asked to formulate questions but must also be able to solve the questions they have created using divergent answers [14]. Through this learning model, students are encouraged to formulate questions based on available information and to think creatively by generating a variety of answers. In this way, students can actively participate in the learning process.

Various previous studies on the Problem Posing learning model indicate that this model can serve as an effective alternative for enhancing students' creative thinking skills. One study demonstrated that students' creative thinking skills improved through the implementation of the Problem Posing learning model [15]. Another study added that the Problem Posing learning model can enhance creative thinking skills, which also has a positive impact on learning outcomes [16]. These findings are supported by research showing that the Problem Posing learning model is effective in enhancing students' creative thinking abilities [17].

Based on the discussion above, this study was conducted to examine the application of the Problem Posing learning model in enhancing students' creative thinking skills as one of the competencies required in the 21st century. Specifically, this study aims to analyze the implementation of the learning syntax, student activities, creative thinking skills, learning outcomes, and student responses following the

application of the problem posing learning model to the topic of Chemical Equilibrium in grade XI.

METHOD

This study employed a quantitative descriptive research design with a pre-experimental approach. The study utilized an experimental group consisting of two classes. The research participants were 11th-grade students at MAS Mambaul Ulum 2 Ponjanaan Timur Batumarmar, Pamekasan, during the even semester of the 2024/2025 academic year. This study was conducted from February to May 2025, aligned with the Chemical Equilibrium curriculum. The research sample was selected using purposive sampling, which involves selecting a sample based on specific criteria relevant to the study's objectives. The sample consisted of Class XI-1 and Class XI-2, each containing 20 students. Both classes were selected because they shared relatively similar characteristics, such as being at the same grade level, studying the topic of chemical equilibrium at the time of the study, and being taught by the same subject teacher. The selection of the research location was based on the results of a pre-study which indicated that students' creative thinking skills regarding the topic of chemical equilibrium still needed improvement; therefore, the school was deemed suitable for the implementation of the problem posing learning model.

The research design used in this study was a One-Group Pretest-Posttest Design. In this design, before the Problem posing learning model was implemented, students took a pretest, and they took a posttest after the model was implemented. Thus, the results of the treatment could be determined more accurately because they could be compared with the situation before the treatment was administered. This research design is presented in Figure 1.

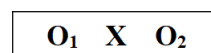


Figure 1. One-Group Pretest-Posttest Research Design

O_1 = Pretest

X = Implementation of the problem posing learning model
O₂ = *Posttest*

[18]

Data for this study were obtained through observations of the implementation of the problem posing learning model, observations of student activities, tests of creative thinking skills and student learning outcomes, and student response questionnaires. The data obtained were then analyzed to formulate the research findings.

Observations of the implementation of the syntax were analyzed by calculating the percentage of implementation for each step in the problem posing learning model syntax using the following formula.

$$\% \text{ Implementation} = \frac{\sum \text{Score Obtained}}{\sum \text{Maximum Score}} \times 100\%$$

The percentage of student activity for each activity was calculated using the following formula.

$$\% \text{ Student Activity} = \frac{\sum \text{Frequency of activities appear}}{\sum \text{Overall activity frequency}} \times 100\%$$

The average percentage of syntax implementation and student activity was interpreted using the assessment criteria in Table 1.

Table 1. Implementation of The Syntax and Student Activity Criteria

Percentage (%)	Criteria
0-20	Very poor
21-40	Poor
41-60	Fairly good
61-80	Good
81-100	Very good

[19]

Problem posing learning model can be said to have been implemented and in accordance with the syntax if the percentage is $\geq 81\%$. Student activity is considered successful and supportive of the implementation of the problem posing learning model in developing creative thinking skills if the percentage is $\geq 81\%$.

Students' creative thinking skills and learning outcomes were analyzed based on the results of pretests and posttests administered to the students. The pretest and posttest results were analyzed using a normality test, specifically the Shapiro-Wilk test because the sample size was less than 50 [20], followed by a parametric test using a

paired sample t-test. These tests were conducted using SPSS 25.

The hypotheses formulated were as follows [21].

- H₀ = There is no increase in students' creative thinking skills after the implementation of the problem posing learning model.
H₁ = There is an increase in students' creative thinking skills after the implementation of the problem posing learning model.

The decision criteria are as follows [22].

If the sig. value is ≥ 0.05 , then H₀ is accepted and H₁ is rejected.

If the sig. value is < 0.05 , then H₀ is rejected and H₁ is accepted.

A student's learning outcomes are considered met on an individual basis if the score obtained by each student based on the minimum passing score (KKM) is ≥ 75 . A class's learning outcomes are considered met if the percentage of students with scores of ≥ 75 reaches $\geq 75\%$. The analysis of classical completeness analysis uses the following formula.

$$\text{Classical Completeness} = \frac{\sum \text{Students who have completed}}{\sum \text{Students}} \times 100\%$$

The student response questionnaire was analyzed by calculating the percentage for each aspect using the following formula.

$$\% \text{ Students Responses} = \frac{\text{Total score from data collection}}{\text{maximum score}} \times 100\%$$

The percentages calculated from the student response questionnaire were interpreted according to the criteria presented in Table 2.

Table 2. Student Response Criteria

Percentage (%)	Criteria
0-20	Very poor
21-40	Poor
41-60	Fairly good
61-80	Good
81-100	Very good

[19]

Student response to learning using the Problem Posing model to enhance creative thinking skills is considered good if it achieves a percentage of $\geq 61\%$ [19].

RESULTS AND DISCUSSION

Implementation of Problem Posing Learning Model

The implementation of the problem posing learning model was assessed through observations conducted by two observers, a chemistry teacher and a student in the chemistry education program at Surabaya State University. These observations were conducted to determine the alignment between the syntax of the problem posing learning model as implemented and the lesson plans that had been prepared. The results of the observations, conducted over two meetings in classes XI-1 and XI-2, are shown in Figure 2.

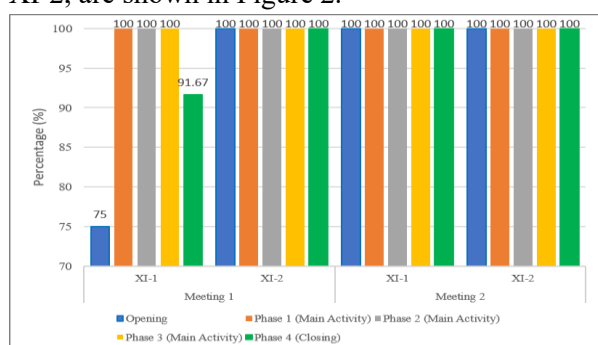


Figure 2. Learning Implementation of The Problem Posing Model Chart of XI-1 and XI-2

The syntax observed in this study refers to the problem posing learning model, which consists of four phases: Stimulation (encouraging students to review the material), Problem Statement (formulating a problem), Verification (checking solutions), and Review (reviewing what was learned) [23].

Based on Figure 2, during the Opening stage, implementation in Class XI-1 during the first meeting reached 75%, while in Class XI-2 it reached 100%. However, during the second meeting, implementation of the Opening stage increased to 100% in both classes, indicating an improvement in the implementation of the learning process. The opening stage serves to prepare students for the subsequent learning activities [24].

In the Main Activities, which included Phase 1, Phase 2, and Phase 3, 100% implementation was achieved in both classes and across all meetings. In Phase 1 (Stimulation), the teacher provided stimuli and explained the material as an initial concept,

then guided the students to make connections between their existing knowledge and the information they received [23]. At this stage, the teacher provided a stimulus in the form of an image of a swimming pool free of algae following the addition of HClO and $\text{H}_3\text{C}_3\text{N}_3\text{O}_3$ (cyanuric acid) in meeting 1. This stimulus was intended to demonstrate the effect of concentration on shifts in chemical equilibrium. Meanwhile, in meeting 2, the stimulus provided was the phenomenon of water vapor and shortness of breath while hiking. These phenomena demonstrate the effects of pressure, volume, and temperature on shifts in chemical equilibrium.

Then, in Phase 2 (Problem Statement), the teacher encourages and guides students to formulate questions or problems related to factors affecting chemical equilibrium and to develop solutions [23]. In this phase, the teacher guides students to create problems related to Le Chatelier's principle, taking into account the indicators of creative thinking skills explained earlier.

In Phase 3 (Verification), the teacher directs students to check the solutions they have created [23]. The teacher selects several students to present the results of their discussions in front of the class, clarifies any misconceptions, and provides reinforcement.

As for Phase 4 (Review), which is part of the Closing Stage, the teacher guides students to review the learning that has taken place. [23]. The review involves summarizing and drawing conclusions about the material that has been studied.

Overall, the average learning implementation rate for both classes reached $\geq 81\%$ and fell into the "Very Good" category. Thus, the learning activities were deemed to have been carried out in accordance with the syntax of the problem posing learning model that was applied.

Student Activities

The observations were conducted by four observers using an observation sheet to track student activities during the learning process, which employed the problem posing model; each observer focused on the students' predominant

behaviors. Observations were taken every 3 minutes over the course of two meetings. The results of the observations of student activities are presented in Table 3.

Table 3. Results of Observations of Student Activities

Student Activity	Percentage (%)			
	Meeting 1		Meeting 2	
	XI-1	XI-2	XI-1	XI-2
A	20,38	19,48	18,24	17,95
B	2,55	2,60	2,52	2,56
C	2,55	2,60	2,52	2,56
D	25,48	25,97	25,16	25,64
E	7,64	7,79	10,06	10,26
F	7,64	7,79	7,55	7,69
G	2,55	2,60	2,52	2,56
H	5,73	4,55	5,66	4,49
I	2,55	2,60	2,52	2,56
J	1,27	1,30	1,26	1,28
K	2,55	2,60	2,52	2,56
L	2,55	2,60	2,52	2,56
M	2,55	2,60	2,52	2,56
N	2,55	2,60	2,52	2,56
O	7,64	7,14	6,92	7,05
P	1,27	2,60	2,52	2,56
Q	2,55	2,60	2,52	2,56
Total	100	100	100	100

Description:

- A. Listen to the teacher's explanation
- B. Read the summary
- C. Read sample questions
- D. Discuss
- E. Formulate questions
- F. Solve the problems
- G. Present
- H. Take notes on important points.
- I. Explain ideas
- J. Answer the teacher's questions.
- K. Interpreting problems
- L. Apply a concept in different ways.
- M. Propose new ideas.
- N. Provide feedback.
- O. Ask questions and seek information
- P. Conclude
- Q. Reflect.

Based on Table 3, it is evident that students' overall activity levels during the implementation of the problem posing learning model were very good. This means that student activity supported the implementation of the problem posing learning model. The high percentage indicates that students

spent most of their learning time engaging in relevant activities and actively participating in the learning process. The most dominant activity was discussion, which indicates that students were actively participating in exchanging ideas, identifying problems, and formulating questions and solutions in groups, in accordance with the student-centered nature of the problem posing model. Table 3 still shows activities with low percentages. These low percentages do not indicate that the activities did not take place, but rather that they required little time, such as answering the teacher's questions and drawing conclusions.

As for irrelevant activities, such as talking off-topic and not paying attention to the teacher's explanations, they did not dominate the learning process. This is supported by the relatively small class size only 20 students per class which makes it easier for teachers to manage the classroom, monitor each student's participation, and provide guidance throughout the learning process.

Students' Creative Thinking Skills

Students' creative thinking skills can be assessed through tests administered before (pretest) and after (posttest) the implementation of the problem posing learning model. The test consisted of four essay-type questions on chemical equilibrium, aligned with the indicators of creative thinking skills: fluency, flexibility, originality, and elaboration. The normality test of the pretest and posttest scores for creative thinking skills was tested. The results are presented in Figure 3.

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest Creative Thinking XI-1	.153	20	.200 [*]	.928	20	.143
Posttest Creative Thinking XI-1	.177	20	.099	.920	20	.101
Pretest Creative Thinking XI-2	.235	20	.005	.912	20	.069
Posttest Creative Thinking XI-2	.119	20	.200 [*]	.974	20	.845

^{*}. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 3. Results of the Pretest-Posttest Normality Test for Creative Thinking Skills

Figure 3 shows that the results of the Shapiro-Wilk test for the pretest and posttest data on creative thinking skills in classes XI-1 and XI-2 are normally distributed (Sig. > 0.05), so the analysis continued using the Paired Sample t-test.

The results of the Paired Sample t-test for creative thinking skills can be seen in Figure 4.

Paired Samples Test									
		Mean		Std. Deviation		Std. Error Mean		95% Confidence Interval of the Difference	

< 0.05), H_0 is rejected and H_1 is accepted. This indicates that there was an improvement in students' learning outcomes after the implementation of the problem posing learning model on the topic of chemical equilibrium, both in Class XI-1 and Class XI-2.

The learning result completeness of students in classes XI-1 and XI-2 is shown in Table 4.

Table 4. Recapitulation of Student Learning Outcomes Completeness

The Completeness of Learning Outcomes	XI-1		XI-2	
	Pre-test	Post-test	Pre-test	Post-test
≥ 75 (Complete)	0	17	0	16
< 75 (Not Complete)	20	3	20	4
Class Completeness (%)	0	85	0	80

Based on the data in Table 4, there was an increase in learning outcomes for students in both Class XI-1 and Class XI-2. This means that there was an improvement in learning outcomes in both classes following the implementation of the problem posing learning model. This indicates that the problem posing learning model can improve students' learning outcomes in the 11th-grade chemistry topic of chemical equilibrium. During the learning process, students were trained to create questions and their answers, so that each student went through the learning process twice. This resulted in an improved understanding of the chemical equilibrium material presented, thereby also improving learning outcomes. The results of this study are consistent with research showing that the problem posing learning model can improve student learning outcomes [27]. Other studies have also reported that improving creative thinking skills through the problem posing model has a positive impact on learning outcomes [16]. However, the completeness of learning outcomes in this study was slightly lower than in previous studies. This difference was influenced by variations in student characteristics, learning materials, educational levels, and the duration of the learning model's implementation.

Student Responses

The data on student responses can be seen in Figure 8.

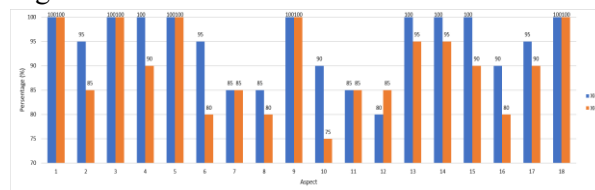


Figure 8. Student Respon Questionnaire Result Class XI-1 and XI-2

Based on Figure 8, student responses to the problem posing learning model were very positive, with percentages ranging from 80% to 100% in classes XI-1 and XI-2. This indicates a positive response from students toward the learning process that was implemented; for example, all students (100%) stated that they enjoyed learning using the problem posing learning model and agreed that this model should be applied to other subjects. Students also stated that the problem posing learning model helps them understand chemical equilibrium concepts, develops creative thinking skills, encourages them to view problems from different perspectives, generates diverse ideas, enables them to present and explain their ideas, and allows them to present the results of discussions. The questionnaire also included negative questions, thus, the high percentage indicates that the majority of students did not experience significant difficulties or obstacles during the learning process. A total of 95% of students in Class XI-1 and 85% of students in Class XI-2 also felt actively engaged in the learning process, students took notes on important points, asked questions, and sought references from various sources.

Overall, the average survey response score for students in both classes reached $\geq 81\%$ and fell into the "Very Good" category. These responses further reinforce that the problem posing learning model is a viable alternative for teaching chemistry, particularly when covering the topic of chemical equilibrium. The students' positive responses are also consistent with research reporting that problem posing instruction receives very positive feedback and that students are satisfied with this instructional model [28].

Based on the research results, the implementation of the problem posing learning model was able to improve students' creative thinking skills. These findings indicate that this model can serve as a viable alternative for instruction, particularly in chemistry. Therefore, teachers can utilize the problem posing model to create a more active learning environment and foster the development of creative thinking skills.

This study still has several limitations, such as the absence of a control group, a limited sample size, and a relatively short implementation period. Therefore, future research is recommended to use an experimental design with a control group so that the effectiveness of the problem posing model can be compared with other learning models. In addition, the research could also involve more students so that the results obtained can provide a broader picture. The problem posing model needs to be applied in future learning and research with a longer implementation period should also be conducted so that students have the opportunity to become more accustomed to problem posing learning, thereby allowing for a more optimal observation of the development of creative thinking skills.

CONCLUSION

The implementation of the problem posing learning model to improve students' creative thinking skills in the Grade 11 chemical equilibrium curriculum received an overall rating of "very good" and was consistent with the applied syntax. This is proven by the average percentage of learning implementation in the first meeting of classes XI-1 and XI-2, which were 91.30% and 100%, respectively, and in the second meeting of classes XI-1 and XI-2, which was 100%. Student activities supported the implementation of the problem posing learning model, with the total percentage for each meeting reaching 100% in both classes. This indicates that students engaged in relevant activities and were actively involved in the learning process. Students' creative thinking skills improved, as evidenced by the Paired-Sample t-test, which showed a significance level (Sig., 2-tailed) of 0.000 for both Class XI-1 and Class XI-2, supported by N-gain scores for each indicator ranging from $0.3 \leq g \leq 0.7$, which is considered a medium criteria. Students' learning outcomes also

improved, with classical completeness rates of 85% and 80%. The student response questionnaire showed positive feedback and excellent results, with an average percentage of 94.44% in Class XI-1 and 89.72% in Class XI-2. This indicates that the problem posing learning model is well-received and effective in improving creative thinking skills on the topic of chemical equilibrium in Grade XI.

ACKNOWLEDGMENTS

I would like to express my gratitude to the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia for funding this research through the Bidikmisi scholarship program.

REFERENCES

1. Prihadi, E. 2018. Pengembangan Keterampilan 4C Melalui Metode Poster Comment pada Mata Pelajaran PAI dan Budi Pekerti. *Jurnal Pendidikan Islam Rabbani*, Vol. 2, No. 1, pp. 464–479.
2. Handajani, S., Pratiwi, H., and Mardiyana. 2018. The 21st Century Skills with Model Eliciting Activities on Linear Program. *Journal of Physics: Conference Series*, Vol. 1008, No. 1, pp. 1–7.
3. Satria, R., Adiprima, P., Kandi, S., and Tracey, Y. H. 2022. *Panduan Pengembangan Projek Penguatan Profil Pelajar Pancasila*. Jakarta: Badan Standar, Kurikulum, dan Asesmen Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia.
4. Balakrishnan, B. 2022. Exploring the Impact of Design Thinking Tool Among Design Undergraduates: A Study on Creative Skills and Motivation to Think Creatively. *Int J Technol Des Educ.*, Vol. 32, No. 3, pp. 1799–1812.
5. Malisa, S., Bakti, I., and Iriani, R. 2018. Model Pembelajaran Creative Problem Solving (CPS) untuk Meningkatkan Hasil Belajar dan Kemampuan Berpikir Kreatif Siswa. *Vidya Karya*, Vol. 33, No. 1, pp. 1–20.
6. Munandar, U. 2009. *Pengembangan Kreativitas Anak Berbakat*. Jakarta: Rineka Cipta.
7. Primadoni, A. B., and Muslim, R. I. 2023. Faktor Rendahnya Keterampilan Berpikir Kreatif dalam Menciptakan Inovasi Baru.

- Jurnal Ilmiah Pendidikan Dasar*, Vol. 08, No. 03, pp. 958–966.
8. Furqon, H. M., and Novita, D. 2020. Kelayakan Perangkat Pembelajaran untuk Melatihkan Keterampilan Berpikir Kreatif Peserta Didik pada Submateri Faktor-Faktor Kesetimbangan Kimia. *Prosiding Seminar Nasional Kimia*, pp. 64–75.
 9. Risnawati and Saadi, P. 2016. Meningkatkan Kemampuan Berpikir Kreatif dan Hasil Belajar Melalui Model Pembelajaran Creative Problem Solving (CPS) pada Materi Larutan Penyangga. *Quantum: Jurnal Inovasi Pendidikan Sains*, Vol. 7, No. 2, pp. 127–134.
 10. Wahid, F. S., Purnomo, M. A., and Ulya, S. M. 2020. Analisis Peran Guru dalam Pemanfaatan Lingkungan Sekolah terhadap Kreativitas Belajar Siswa. *Jurnal Ilmiah Kontekstual*, Vol. 2, No. 01, pp. 38–42.
 11. Simanjuntak, F. E., Erviyenni, and Noer, A. M. 2019. Penerapan Model Pembelajaran Creative Problem Solving (CPS) Tipe Treffinger untuk Meningkatkan Berpikir Kreatif pada Pokok Bahasan Larutan Penyangga. *J-PEK (Jurnal Pembelajaran Kimia)*, Vol. 4, No. 2, pp. 81–87.
 12. Allo, E. L., and Pasae, Y. 2024. Systematic Literature Review: Keterampilan Berpikir Kreatif dalam Pembelajaran Kimia pada Tingkat SMA di Indonesia. *Jurnal Chemica*, Vol. 25, No. 1, pp. 82–93.
 13. Daniati, S. P., Yulianti, H. M., and Kamsiyati, S. 2016. Peningkatan Kemampuan Menghitung Bilangan Bulat melalui Model Pembelajaran Problem Posing. *Jurnal Didaktika Dwija Indria*, Vol. 4, No. 4.
 14. Shoimin, A. 2014. *68 Model Pembelajaran Inovatif dalam Kurikulum 2013*. Yogyakarta: Ar-ruzz Media.
 15. Diyanah, M., and Firdausi, Y. N. 2018. Meningkatkan Kemampuan Siswa pada Aspek Berpikir Kreatif Matematika Melalui Pembelajaran Problem Posing. *Jurnal Elektronik Pembelajaran Matematika*, Vol. 5, No. 2, pp. 163–172.
 16. Larasati, D. R., Wahyudi, and Indarini, E. 2019. Penerapan Model Problem Posing untuk Meningkatkan Kemampuan Berpikir Kreatif dalam Pembelajaran Matematika Sekolah Dasar. *DAYA MATEMATIS: Jurnal Inovasi Pendidikan Matematika*, Vol. 7, No. 2, pp. 146–156.
 17. Shofi, M., and Wulandari, E. 2023. Keefektivan Pembelajaran Problem Posing Terhadap Penguatan Creative Thinking Siswa SMA. *PYTHAGORAS: Jurnal Program Studi Pendidikan Matematika*, Vol. 12, No. 2, pp. 116–127.
 18. Sugiyono. 2015. *Metode Penelitian dan Pengembangan (Research and Development)*. Bandung: Alfabeta.
 19. Riduwan. 2015. *Skala Pengukuran Variabel-Variabel Penelitian*. Bandung: Alfabeta.
 20. Fauzi, I. 2026. *Statistik Penelitian Pendidikan Panduan Praktis Analisis Data Statistik Melalui Aplikasi SPSS-26*. Semarang: Badan Penerbit STIEPARI Press.
 21. Sugiyono. 2018. *Educational Research Methods Quantitative, Qualitative, and R&D Approaches*. Bandung: Alfabeta.
 22. Arikunto, S. 2002. *Metodologi Penelitian Suatu Pendekatan Proposal*. Jakarta: PT Rineka Cipta
 23. Irawati, R. K. 2014. Pengaruh Model Problem Solving dan Problem Posing serta Kemampuan Awal terhadap Hasil Belajar Siswa. *Jurnal Pendidikan Sains*, Vol. 2, No. 4, pp. 184–192.
 24. Karim, A., Fathurrohman, M., and Yuhana, Y. 2024. Implementasi Supervisi Akademik Kepala Sekolah di SMP Negeri 5 Gunungkencana. *Jurnal Kajian Pendidikan dan Pengajaran*, Vol. 10, No. 1, pp. 12–21.
 25. Afiyanti, E. N., and Rusmini. 2024. Pengembangan LKPD Berbasis Problem Posing untuk Meningkatkan Keterampilan Berpikir Kreatif pada Materi Kesetimbangan Kimia. *UNESA Journal of Chemical Education*, Vol. 13, No. 1, pp. 60–69.
 26. Toheri, Winarso, W., and Haqq, A. A. 2020. Where Exactly for Enhance Critical and Creative Thinking: The Use of Problem Posing or Contextual Learning. *European Journal of Educational Research*, Vol. 9, No. 2, pp. 877–887.

27. Parindra, W. D., Sentosa, A. B., and William, N. 2021. Pengaruh Model Pembelajaran Problem Posing Terhadap Hasil Belajar Siswa Pada Pembelajaran Tematik. *Jurnal Riset dan Inovasi Pendidikan Dasar*, Vol. 1, No. 2, pp. 91–99.
28. Pusfita, D., and Fitriyani, H. 2017. Penerapan Model Pembelajaran Problem Posing untuk Meningkatkan Kreativitas. *Seminar Nasional Pendidikan, Sains dan Teknologi Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Muhammadiyah Semarang*, pp. 71–77.