HYDROGEN
JURNAL KEPENDIDIKAN KIMIA
https://e-journal.undikma.ac.id/index.php/hydrogen/index

June 2025. 13(3)
e-ISSN: 2656-3061
p-ISSN: 2338-6487
pp. 554-567

Improving Students' Creative Thinking Skills through Problem Based Learning on Colloid: A Lesson Study Practice

Siti Munawaroh[1*], Herunata[1], Silviani[2]

[1] Teacher Professional Education, Postgraduate School, State University of Malang, Jalan Semarang 5, Malang, Indonesia 65145

[2] Senior High School 2 Malang, Jl. Laksamana Martadinata No. 84, Sukoharjo, Klojen, Malang, Indoensia 65118

[*] Corresponding Author e-mail: siti.munawaroh.2431279@students.um.ac.id

Article History
Received: 24-05-2025
Revised: 12-06-2025
Published: 30-06-2025

Keywords: problem based learning; lesson study; students creative thinking skills; colloid

Abstract

This research aims to improve students' creative thinking skills with the Problem Based Learning (PBL) model assisted by google sites through the practice of lesson studies on colloid materials. This research method is Classroom Action Research (CAR) which involves a Lesson Study (LS) conducted for two cycles. Cycle I was carried out on the sub-matter of difference in solution, colloids, and suspensions, types and properties of colloids with mindmapping activities. Meanwhile, Cycle II was carried out on material on how to make colloids with activities to make colloid-based product design designs. The sample of this study is 34 students in grades XI-C at state senior high school (SMAN) 2 Malang for the 2024/2025 Even Semester Academic Year. Data was collected through observation sheets and creative thinking skills questionnaires based on Torrance indicators, namely: *fluency*, *flexibility*, *originality*, and *elaboration*. The results showed a significant increase in the average score of students' creative thinking skills from 1.97 (adequate) in cycle I to 2.64 (good) in cycle II. The highest increase occurred in the *elaboration* and *flexibility* indicators, while the *originality* indicator increased but was still quite sufficient. These findings show that the integration of context-based digital media with the PBL model as well as reflective practices such as lesson studies can gradually and significantly improve students' creative thinking skills.

How to Cite: Munawaroh, S., Herunata, H., & Silviani, S. (2025). Improving Students' Creative Thinking Skills through Problem Based Learning on Colloid: A Lesson Study Practice. Hydrogen: Jurnal Kependidikan Kimia, 13(3), 554-567. doi:https://doi.org/10.33394/hjkk.v13i3.15840

https://doi.org/10.33394/hjkk.v13i3.15840

INTRODUCTION

Chemistry is a part of science that focuses on the properties of substances, changes in substances, the laws and principles that govern the change of substances, as well as the concepts and theories that explain the phenomenon of change in substances (Effendy, 2016). Based on literature studies and observations in schools, the implementation of chemistry learning in schools still has problems that must be a concern. The creative thinking ability of Indonesian students is ranked 115 out of 139 countries with an index of 0.202 (Ulfa & Wijayanti, 2019). This shows that this ability is still relatively low. Research by Nuraini & Hidayah (2022) shows that students experience deficiencies in creative thinking skills. This is because students are not used to creating new ideas or ideas and are not used to producing varied answers and views (Ernawati et al., 2022). This condition can also be seen from the initial findings of the researcher during observation in class on the previous material, namely the reaction rate.

During the poster making activity of the reaction rate practicum in groups, at least 10 out of 34 students actively submitted alternative ideas in making posters. Most students simply agree with a friend's opinion without giving another point of view. There is even one group that cannot develop new ideas to make posters well. Based on the results of the teacher's

observations, students still find it difficult to develop new ideas and are more comfortable memorizing formulas and definitions. The ability to generate new ideas is one of the skills of creative thinking. According to Costa and Presseisen (1985), creative thinking skills are individual skills that use the thought process to produce new constructive ideas based on rational concepts and principles as well as individual perceptions and intuitions. This shows that students' creative thinking skills are still relatively low and need attention.

Creative thinking is one of the higher-order thinking skills (Sutrimo et al., 2019). Creative thinking is a cognitive process used by individuals to analyze, make plans, conduct investigations, then make conclusions and identify assumptions until the right solution is finally obtained (Ceylan, 2022; Syahrial et al., 2020). Torrance identified four main aspects of creative thinking indicators, namely *fluency*, *flexibility*, *originality*, and *elaboration* (Pellegrin et al., 2019). Creative thinking skills are skills needed by the 21st century that aim to prepare students to face global challenges. One way to practice these creative thinking skills is through contextual-based learning, such as in collloidal materials.

Colloids are a topic relevant to everyday life, as they are widely found in various products, such as food, cosmetics, and medicines. Colloidal is a subject whose concept is abstract and descriptive so that most students learn it by memorization. This makes it difficult for students to relate the material learned to real life, making the learning process monotonous and less effective (Hezbollah & Hassan, 2022). Learning that relies solely on memorization does not provide a deep understanding and connection between theory and practice, which is necessary to encourage critical and creative thinking in students (Halim, 2022). Colloidal is a topical topic and is widely found in daily life so it is very suitable for improving students' creative thinking skills that focus on real application-based applications.

Learning should be designed to create active teaching moments, including discussion, experimentation, problem-solving, and technology utilization (Klopfer & Aikenhead, 2022). With this, students not only understand colloidal concepts, but can also apply them in real-life situations, creating connections between theory and practice that are crucial in science learning. It is important to create connections between theory and practice that facilitate a deeper understanding (Asiyah et al., 2021). One of the learning models that can be used is problem-based learning (PBL). The Problem Based Learning (PBL) model is a learning approach that emphasizes the application of real problems as contextualization for students in the learning process. The use of the PBL model in learning makes students process information appropriately and creatively, overcome and solve the problems given, and improve students' learning skills and achievements (Sakir & Kim, 2020; Tanti et al., 2021).

This approach encourages students to be active in finding solutions to the problems they face, thereby improving students' creative thinking skills. Research conducted by Mz et al. (2021) shows that PBL can improve students' creative thinking skills through specially designed structured learning tools. According to Sani (2015), the steps of the PBL model are: (1) orienting students to problems, (2) organizing students to learn, (3) conducting investigations, (4) developing and presenting work results, and (5) analyzing and evaluating the results of problem solving.

The Problem-based Learning (PBL) learning model requires the active involvement of students in identifying and solving contextual problems, so learning media is needed that not only presents material but is also able to support the process of exploration and student learning independence. The use of Google Sites-based technology learning media in this context is very relevant as an interactive learning medium that can be used to compile material systematically and easily accessible to students. Google Sites allows for wider and more flexible access for students to get information and learning materials, in line with the ever-evolving advances in educational technology (Jannah et al., 2024; Prayudi & Anggriani, 2022). The use of google

sites has a direct impact on the effectiveness of PBL implementation. The Google site supports the characteristics of PBL by providing *flexibility* in accessing information, enabling collaboration, and facilitating students to manage and explore material independently. The quality of learning with the PBL model using google sites media can be improved through the practice of lesson study.

Lesson study is a professional development activity that originated in Japan and has been adopted by educators around the world (González & Deal, 2019). Lesson study serves as a tool for teachers to collaborate, where they can jointly plan, observe, and reflect on teaching practices to improve the quality of learning they face. The results of the study show that lesson study can improve the ability of educators in the implementation of learning (González & Deal, 2019). The practice of lesson study has proven to be very effective in increasing teachers' attention to learning and improving their content and pedagogical knowledge. This collaborative approach provides an opportunity for teachers to observe and understand students' thoughts (Viantri & Asriningsih, 2016). By engaging in lesson study, educators can continue to refine their teaching methods, ultimately improving the overall quality of education.

This research aims to improve students' creative thinking skills with the Problem Based Learning (PBL) model assisted by google sites through the practice of lesson studies on colloid materials. In contrast to previous research which generally focused on the use of conventional media, this study uses google sites as an interactive learning medium that makes it easier for students to access materials and worksheets digitally anywhere and anytime. This study also applies a structured lesson study cycle (*Plan, Do, See*) to evaluate and improve the effectiveness of PBL assisted by google sites in learning chemistry on colloidal topics.

METHOD

This research is a qualitative and quantitative research. This research was carried out in the practice of Lesson Study in CAR (Class Action Research). The procedure for implementing lesson studies is carried out in a series of activities called a cycle. The implementation of colloidal material learning is recognized in two cycles of CAR. The stages of Class Action Research can be seen in Figure 1.

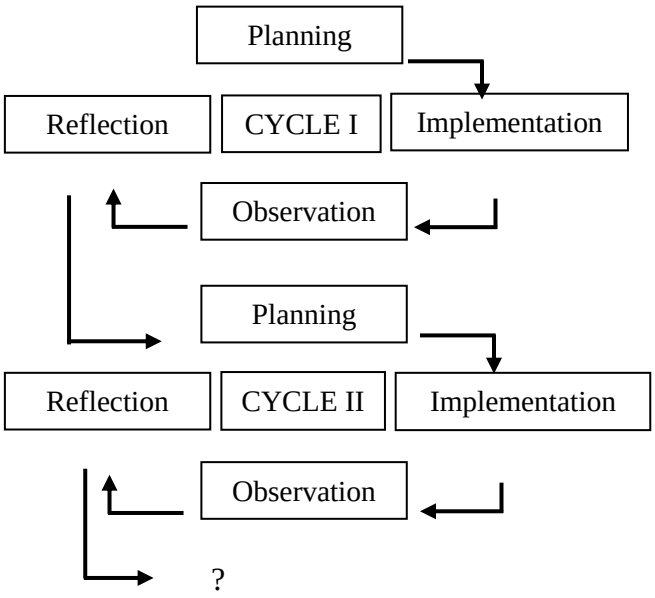


Figure 1. Stages of Classroom Action Research

Each lesson study cycle consists of three stages, namely *Plan* (planning), *Do* (implementation), and *See* (reflection). This activity began with a discussion with pamong teachers, DPL, and fellow PPG students who aimed to analyze learning problems. The focus of the problem to be solved is to train students' creative thinking skills by integrating them with the problem-based learning model assisted by Google Sites learning media on colloid materials.

During the *Plan* phase, all participants discuss specific objectives, student needs, teaching modules, and Google Sites learning media to use. In the *Do* stage, one of the participants becomes a model teacher who conducts an open class (OC) and the other participant becomes an observer who observes the teaching and learning process such as the teacher's actions, student activities, and student-teacher interactions as well as student-student interactions. After that, all participants are involved in the implementation of the *See* stage or reflect.

The research sample consisted of 34 students of XI-C state senior high school (SMAN) 2 Malang selected purposively. Instruments included teaching modules, Google Sites-based media, lesson study observation sheets, and creative thinking skills questionnaires based on Torrance's indicators (Pellegrin et al., 2019).

Table 1. Creative thinking skills indicators

Indicator	Description
Fluency	Generating several ideas/answers to a problem; expressing ideas smoothly; identifying errors.
Flexibility	Producing various interpretations; different ways to solve problems; classifying differently.
Originality	Producing new ideas from existing ones related to a problem.
Elaboration	Exploring meanings through detailed steps; elaborating previous ideas; analyzing new details.

(Pellegrin et al., 2019)

The value of students' creative thinking skills is calculated using the following formula:

$$\text{Value} = \frac{\sum Total\ score\ obtained}{Maximum\ Score\ Amount} \text{ x } 4$$

The results of the calculation of student scores can be interpreted based on the Table 2.

Table 2. Creative thinking skill score criteria

Score	Criteria
$3.33 < \text{score} \leq 4$	Very Good
$2.33 < \text{score} \leq 3.33$	Good
$1.33 < \text{score} \leq 2.33$	Fair
< 1.33	Poor

(Permendikbudristek No. 21 of 2022 concerning Education Assessment Standards)

The research data is in the form of quantitative and qualitative data. Quantitative data came from a questionnaire on creative thinking skills for observers. Meanwhile, the qualitative data comes from the observation sheet of the lesson study. Qualitative data was analyzed through triangulation of data on observation lesson studies from observers.

Data triangulation was carried out to increase the validity of the results. This is comparing the students' creative thinking skills questionnaire by the observer with the results of the learning observation in lesson study activities and the record of each student's creative thinking skills from the observer during the *See* stage

RESULTS AND DISCUSSION

This study implements lesson study practice in the form of *Open Class* which takes place in two cycles. Based on (Coenders & Verhoef, 2019; Fujii, 2019; Seino & Foster, 2021; Vermunt et al., 2019) Lesson Study is an approach to professional teacher development that has several important aspects:

(1) Collaborative Approach, Lesson Study is an approach that involves cooperation between a group of teachers or education practitioners. They work together to design, implement, and reflect on a lesson.

(2) Joint planning, in lesson study, teachers plan lessons together where they can design learning objectives, teaching strategies, and determine the materials and data sources to be used in the lesson.

(3) Observation of lessons, one of the teachers in the group will be the model teacher who will teach the lesson that has been planned. The other teachers in the group will observe the lesson closely.

(4) Joint reflection, after the lesson is over, the teacher group will gather to do reflection together. They will discuss what happened during the lesson, what worked, and what needs to be improved. This reflection is an important part of Lesson study because it allows teachers to learn from each other and improve their teaching practices.

(5) Iteration, if areas of improvement are found during reflection, the group of teachers can change and improve their lessons. It is a continuous cycle in which lessons are planned, taught, observed, and reflected, and then improved again. Lesson study focuses on teacher professional development through deep reflection and real-world experience in teaching so as to improve the quality of teaching, help teachers to better understand how students learn, and encourage strong collaboration among educators.

The partner in this activity is SMA Negeri 2 Malang and involves several parties as observers, a total of four teachers professional education students, one field supervisor, and one pamong teacher.

Cycle I

The Open Class Cycle 1 activities started with the *Plan* stage, which involved designing the learning tools including the Teaching Module and interactive learning media based on Google Sites containing Student Worksheets based on liveworksheet. Next, in the *Do* stage, the learning process in the classroom used the Problem-Based Learning (PBL) model with Google Sites media on the topic of differences between solutions, colloids, and suspensions, as well as types and properties of colloids. The learning strategy used in Cycle I was making Mindmaps. During the learning process, all learning activities were observed by observers who collected evidence of students' creative thinking skills and reported their findings in the *See* activity. Based on the observers' findings, the researcher made improvements to the learning to obtain better learning outcomes. The results were then evaluated to improve students' creative thinking skills by changing the learning strategy in the next cycle to project-based learning, namely designing colloid-based product designs.

Cycle II

The Open Class Cycle II activities followed the same stages as Cycle I. The difference lay in the strategy used, where students were challenged to design colloid-based product designs. This strategy was chosen based on observer findings in Cycle I. The topic in Cycle II was the method of making colloids. The researcher conducted Cycle II Open Class by considering mistakes that occurred in Cycle I.

The assessment results of students' creative thinking skills based on observer findings in Cycle I and Cycle II are presented in Table 3.

Table 3. Average scores of creative thinking skills

Indicator	Cycle I		Cycle II	
	Value	Criteria	Value	Criteria
Fluency	1.97	Adequate	2.79	Good
Flexibility	1.97	Adequate	2.73	Good
Originality	1.55	Adequate	2.09	Adequate
Elaboration	2.15	Adequate	2.97	Good
Total	**1.97**	**Adequate**	**2.64**	**Good**

Based on the average scores of creative thinking skill indicators in Table 3, students can be categorized into four levels: very good, good, adequate, and poor according to Table 2. The levels of students' creative thinking skills are shown in Table 4.

Table 4. Levels of students' creative thinking skills

Criteria	Cycle I		Cycle II	
	Percentage	Number of Students	Percentage	Number of Students
Very Good	0%	0	0%	0
Good	17.6%	6	85,3%	29
Adequate	58.8%	20	14,7%	5
Poor	20.6%	7	0%	0

The results show a significant improvement from Cycle I to Cycle II in all creative thinking indicators. *Fluency* score increased from 1.97 to 2.79. *Flexibility* score rose from 1.97 (adequate) to 2.73 (good). *Originality* increased from 1.55 (adequate) to 2.09 (adequate). Meanwhile, *elaboration* improved from 2.15 (adequate) to 2.97 (good). In Cycle I, students categorized as good, adequate, and poor were 17.6%, 58.8%, and 20.6% respectively. These percentages improved in Cycle II, with 85.3% and 14.7% students categorized as good and adequate respectively. This improvement occurred because students were able to develop various ideas and integrate the material learned into their product designs.

Comparison of Cycle I and Cycle II

In the first cycle, the use of mind mapping showed its effectiveness in encouraging students' creative thinking skills, especially in the *elaboration* aspect. This can be seen from the diversity of colors and the grouping of information in the mind map compiled by students. This diversity shows the ability of students to enrich, develop, and organize existing information, in line with the characteristics of *elaboration* in creative thinking (Torrance, 1974). Students are able to elaborate on details, add details, and expand on the ideas that have been learned, thus creating a comprehensive and structured visualization of information. Although mind mapping facilitates *elaboration*, this strategy is not optimal in encouraging students to produce truly original ideas. Most students still exhibit a uniform pattern of thinking, with ideas that tend to follow common patterns that studied before and less exploration of unique new ideas.

The limitations of mind mapping in encouraging *originality* can be explained by the inherent nature of the technique. Mind mapping tends to be structural and based on logical associations of concepts that have been understood, not of the discovery of new ideas (Buzan & Buzan, 2000). In other words, mind mapping helps students in deepening their understanding and mapping of information, which is a hallmark of *elaboration*, but is not strong enough in pushing students out of the conventional thinking zone towards a more divergent and original mindset. This finding is strengthened by research by Fitriani et al. (2020) who stated that

mindmapping can help students understand concepts and develop students' creative thinking skills gradually, although it is not optimal in encouraging truly original thinking.

In cycle II, students are given the challenge to make a design of colloid-based product designs from processed food or beverages. The results showed a significant improvement in all creative thinking indicators, especially in the aspects of authenticity and *flexibility*. Students are able to develop a variety of unique ideas relevant to daily life and integrate colloidal materials in their designs. The resulting product design not only reflects an understanding of how to manufacture colloids, but also demonstrates innovative thinking skills, such as selecting tools and materials, devising colloid manufacturing procedures, and evaluating the process.

The improvement in creative thinking skills between Cycles I and II is shown in Figure 2.

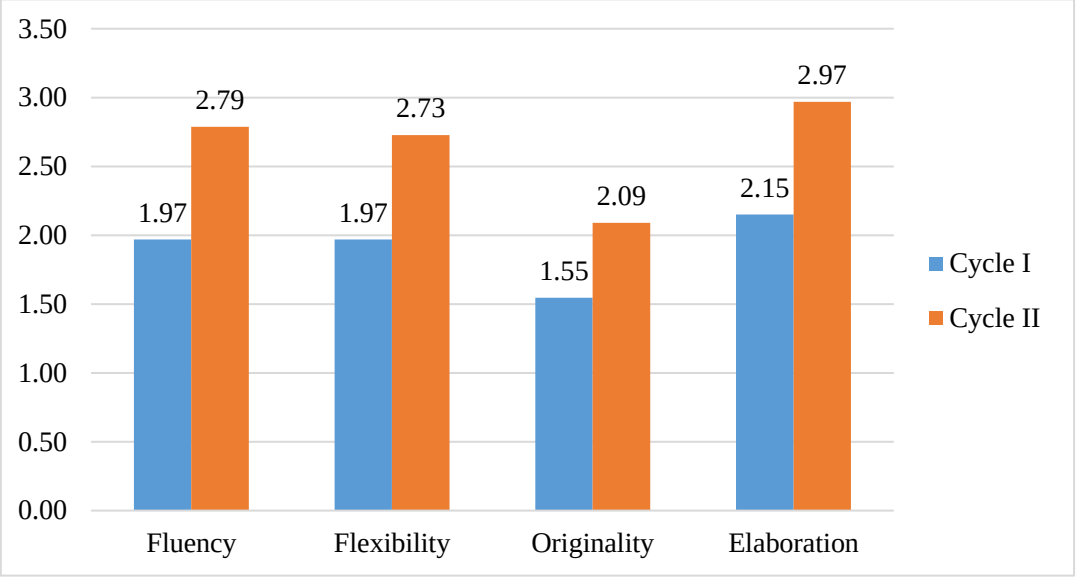


Figure 2. Improvement of average creative thinking skill scores

Table 5. Comparison creative thinking skills of strategies in cycle I and cycle II

Indicator	**Cycle I** (Mindmapping)	**Cycle II** (Colloid-Based Product Design Creation)
Fluency	Adequate	Good
Flexibility	Adequate	Good
Originality	Adequate	Adequate
Elaboration	Adequate	Good

Figure 2 shows the increase in the average score of each indicator of students' creative thinking skills from Cycle I to Cycle II. The most significant increase occurred in the *Elaboration* and *Flexibility* aspects, while *Originality* increased but was still in the "adequate " category. This strengthens the finding that changes in learning strategies in cycle II have a positive impact on the development of students' creativity.

Despite the improvement in creative thinking skills in general, the results on the *originality* indicator showed that the score was still classified as "adequate" in both cycles. This low score indicates that students are not yet fully capable of coming up with completely new and original ideas. *Originality* does not increase significantly due to several factors. First, the free exploration of ideas has not yet become a major part of the student learning experience. Previous learning environments that emphasized more on memorization or one correct answer allowed students to be less able to adapt or adapt quickly to the new approach used by teachers. These behaviors limit the development of students' divergent mindsets necessary for creative thinking skills (Ongowo, 2025).

Divergent thinking (D-thinking), one of the key components of creativity, focuses on new generations of ideas that are useful for solving existing problems (Guilford, 1967 in Jia et al., 2022). Second, in cycle I, mind mapping helps people organize and retain knowledge both orally and in writing by strengthening their visual learning processes (Pane, 2022; Widiyono, 2021), is not the creation of new ideas. This makes students only reproduce information from the sources provided. Third, in cycle II, although the activity of making colloids-based product design activities provides a wider space for exploration, some students still rely on familiar references or product examples, not from their personal ideas.

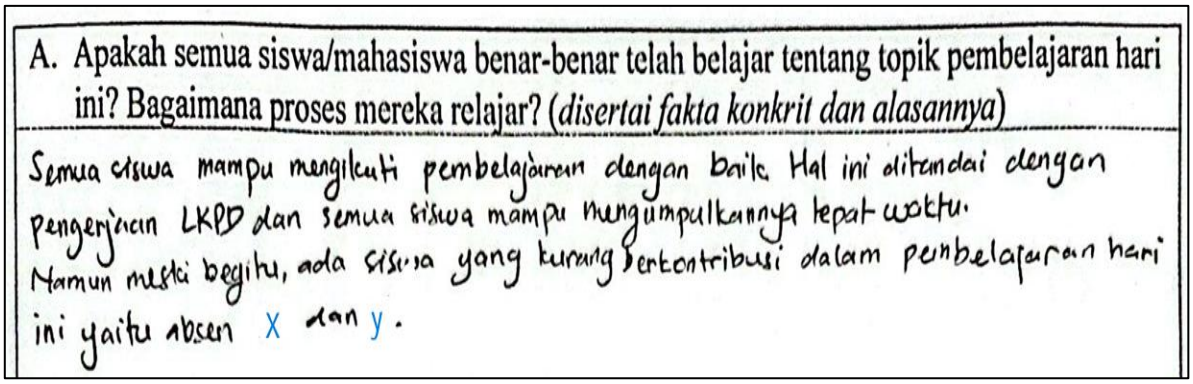
This study result in line with the observation results of observers where there is a group of students who only make colloids-based product designs from familiar products such as jam, jelly, and mayonnaise. So teachers need to foster a mindset where students can develop new ideas even though they are not perfect at first. This finding is in accordance with the statement of Fitriani et al. (2020), that the development of original ideas requires gradual habituation and the right stimulus. To encourage improvement in the aspect of *originality*, further learning can involve strategies that provide space for experimentation of ideas, such as open design, free brainstorming, or mini exhibitions of works so that students are more confident in conveying unique ideas (Xu et al., 2024).

Overall, there was an increase in students' creative thinking scores from cycle I to cycle II based on the data collected. The problem-based learning model using goolge sites learning media with different strategies used in cycle I (mind map) and cycle II (colloid-based product design design) can improve creative thinking skills in understanding colloidal material as a whole.

Learning Observation in Lesson Study Activities

At the *See stage* in the Lesson Study (LS) activity, model teachers and observers reflect on the learning that has been carried out in cycle I and cycle II. The observer conveyed his reflection based on the instruments of the learning observation sheet in LS activities and the creative thinking skills questionnaire which contains a record of each student's creative thinking skills that have been filled out by each observer. The qualitative data obtained were then analyzed through triangulation which aimed to increase the validity of the results, namely by comparing the students' creative thinking skills scores with the results of learning observations in LS activities and the records of each student's creative thinking skills by observers.

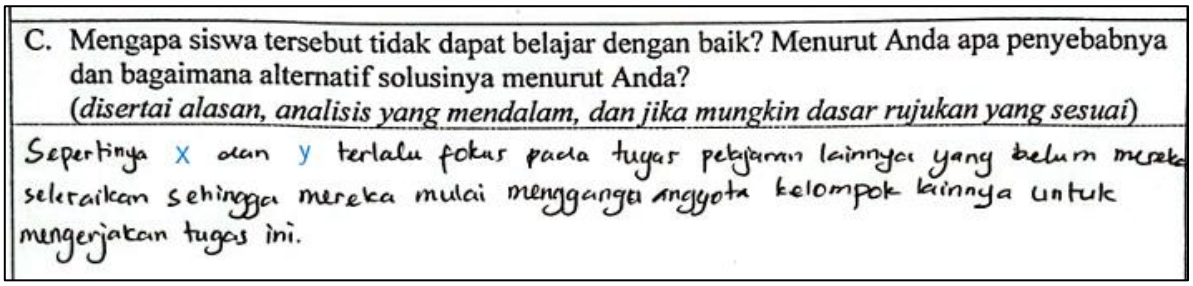
Based on table 4. In the first cycle, there were 20.6% of students or 7 out of 34 students who had poor creative thinking skills, namely the score range of 1 – 1.25. Based on the results of the observation sheet of learning in LS activities by one of the observers who observed some of the students, comments were obtained which can be seen in Figure 3.


A. Apakah semua siswa/mahasiswa benar-benar telah belajar tentang topik pembelajaran hari ini? Bagaimana proses mereka relajar? (*disertai fakta konkrit dan alasannya*)

Semua siswa mampu mengikuti pembelajaran dengan baik. Hal ini ditandai dengan pengerjaan LKPD dan semua siswa mampu mengumpulkannya tepat waktu.
Namun meski begitu, ada siswa yang kurang berkontribusi dalam pembelajaran hari ini yaitu absen X dan y.

Figure 3. First observer's answer to question a in cycle i

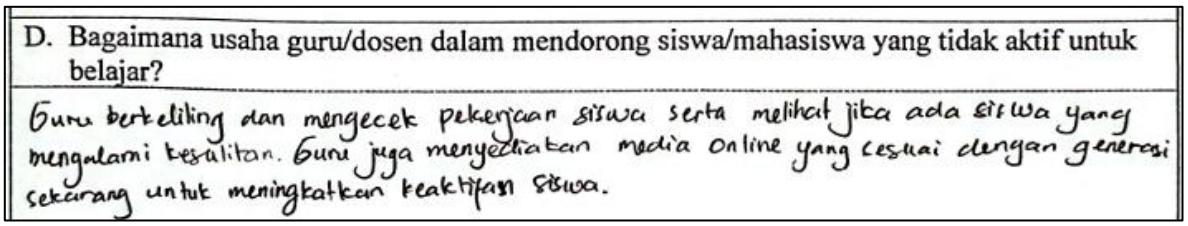
The observation sheet also explains why students cannot take part in today's learning activities which can be seen in Figure 4.


C. Mengapa siswa tersebut tidak dapat belajar dengan baik? Menurut Anda apa penyebabnya dan bagaimana alternatif solusinya menurut Anda?
(*disertai alasan, analisis yang mendalam, dan jika mungkin dasar rujukan yang sesuai*)

Sepertinya X dan Y terlalu fokus pada tugas pelajaran lainnya yang belum mereka selesaikan sehingga mereka mulai menggangu anggota kelompok lainnya untuk mengerjakan tugas ini.

Figure 4. First observer's answer to question c in cycle i

In the observation sheet, it is also explained how the teacher's efforts in encouraging students to actively learn can be seen in Figure 5.


D. Bagaimana usaha guru/dosen dalam mendorong siswa/mahasiswa yang tidak aktif untuk belajar?

Guru berkeliling dan mengecek pekerjaan siswa serta melihat jika ada siswa yang mengalami kesulitan. Guru juga menyediakan media online yang sesuai dengan generasi sekarang untuk meningkatkan keaktifan siswa.

Figure 5. First observer's answer to question d in cycle i

The first observer also provided a record of creative thinking skills for the deficient students seen in Figure 6.

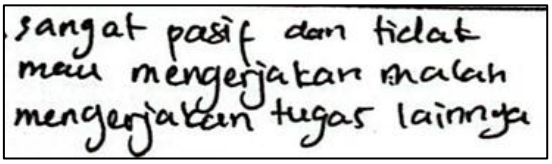
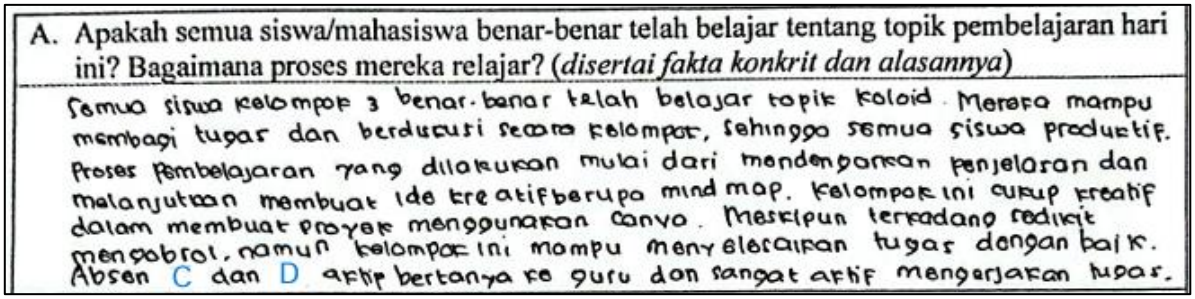

sangat pasif dan tidak mau mengerjakan malah mengerjakan tugas lainnya

Figure 6. record of creative thinking skills by the first observer in cycle i

As for students who have sufficient and good creative thinking skills in cycle I, the second observer provides comments that can be seen in Figure 7.


A. Apakah semua siswa/mahasiswa benar-benar telah belajar tentang topik pembelajaran hari ini? Bagaimana proses mereka relajar? (*disertai fakta konkrit dan alasannya*)

Semua siswa kelompok 3 benar-benar telah belajar topik koloid. Mereka mampu membagi tugas dan berdiskusi secara kelompok, sehingga semua siswa produktif. Proses pembelajaran yang dilakukan mulai dari mendengarkan penjelasan dan melanjutkan membuat ide kreatif berupa mind map. Kelompok ini cukup kreatif dalam membuat proyek menggunakan canva. Meskipun terkadang sedikit mengobrol, namun kelompok ini mampu menyelesaikan tugas dengan baik. Absen C dan D aktif bertanya ke guru dan sangat aktif mengerjakan tugas.

Figure 7. Second Observer's Answer to Question A in cycle I

The second observer also provided notes on students' creative thinking skills with the categories of sufficient (C) and good (B) which can be seen in Figure 8.

Based on the observation sheet by the observer in cycle I, the model teacher and observer reflect on the learning process and realize the need to improve students' creative thinking skills. So that the model teacher changed the mindmapping strategy in the first cycle with the activity of making colloids-based product design in the second cycle. As a result, there was an increase in students who had good creative thinking skills, from 17.6% to 85.3%.

	Catatan	Jumlah Skor	Kriteria
A	Meskipun awalnya kurang fokus, namun mampu menyumbangkan isi dari mindmap	2	C
B	Siswa ini menyumbangkan ide dalam mendesain mindmap menggunakan canva.	2	C
C	Sangat aktif dalam mencari ide, dan menyumbangkan gagasan. Terkadang ide-nya unik.	2,75	B
D	Aktif dalam mencari ide, menyumbangkan gagasan yang terkadang unik.	2,75	B
E	Ikut serta atau aktif dalam mencari isi mindmap yang akan dibuat.	2	C

Figure 8. Record of creative thinking skills by the second observer in cycle I

The record by the second observer for group 3 in cycle II are shown in Figure 9.

A. Apakah semua siswa/mahasiswa benar-benar telah belajar tentang topik pembelajaran hari ini? Bagaimana proses mereka relajar? (*disertai fakta konkrit dan alasannya*)
Kelompok ini benar-benar telah belajar topik koloid. Kelompok ini membagi tugas dan berdiskusi secara berkelompok. Meskipun hanya beberapa siswa yang sangat aktif absen C dan D. Namun, anggota lainnya juga ikut serta menyumbangkan ide dalam menyelesaikan permasalahan.

Figure 9. Second Observer's Answer to Question A in cycle II

The second observer also gave a note on the creative thinking skills of some students which can be seen in Figure 10.

Siswa	Catatan	Jumlah Skor	Kriteria
A	Ikut serta memberikan ide dalam mengerjakan LKPD.	2,5	B
B	Siswa ini ikut serta dalam menyelesaikan permasalahan yang diberikan.	2,5	B
C	Memberikan ide membuat Marshmallow dan ide-ide lainnya yang unik, dan mengerjakan LKPD.	3,25	B
D	Memberikan ide unik dan mengerjakan LKPD yang diberikan	3	B
E	Siswa ini ikut serta dalam menyele saikan permasalahan yang diberikan.	2,5	B

Figure 10. Record of creative thinking skills by the second observer in cycle II

Based on the following observation sheet, it shows that in cycle II, students can be more active in providing alternative ideas in group discussions and developing ideas to make better colloids-based product designs. This is supported by the students' creative thinking skills score which shows an increase from cycle I to cycle II based on table 3. In this second cycle, students can think divergently. According to Guilford, (1956), divergence is the ability to explore ideas from various disciplines and fields of study in order to achieve a deeper understanding of the world and one's role in it. Guilford (1956) stated that divergent thinking can produce more creative and resilient students. Instead of presenting a series of problems to memorize or solve on a regular basis, it is better to present open-ended problems and encourage students to develop their own solutions. Guilford (1956) also revealed that divergent production is a creative process in producing various answers to a problem.

Thus, lesson study is not only a tool for teacher reflection but also a collaborative and effective method of teacher professional development to improve students' creative thinking skills.

CONCLUSION

The application of lesson study practice with the Problem Based Learning model assisted by Google Sites in two Open Class cycles at SMA Negeri 2 Malang has proven to be effective in improving students' creative thinking skills in colloidal materials. In cycle I, the mind mapping strategy facilitates students to organize the basic concepts of solutions, colloids, and suspensions, types and properties of colloids; indicators of *fluency* and *elaboration* are improved, but *originality* is still limited. These findings emphasize the need for activities that provide more room for exploration. Improvements were made in cycle II through the task of designing colloids-based product designs.

As a result, the average score of creative thinking skills increased from 1.97 (adequate) to 2.64 (good) and the percentage of students with the "good" criterion increased from 17.6% to 85.3%. Colloid-based product design activities encourage an increase in creative thinking skills scores in the second cycle, especially *flexibility* and *originality*. This is because students relate the concept of chemistry to real situations. Thus, the use of google sites-based learning media using the problem-based learning model through lesson study practice can improve students' creative thinking skills. The novelty of the findings of this study lies in the combination of the use of interactive media of google sites in the PBL model supported by the practice of lesson studies.

Lesson studies can help teachers plan, reflect and evaluate collaboratively so as to allow for more effective learning improvements to improve students' creative thinking skills. This research is expected to contribute to the practice of chemistry learning as well as research in the field of chemistry education. This research shows that there is an increase in creative thinking skills, especially in colloid materials. Although the improvement is classified as the Good criterion, these results show that the application of the PBL model through the practice of lesson study can encourage student involvement in the learning process and connect chemical concepts with real life. This study provides important insights on the integration of PBL assisted by google sites and lesson study practices in the field of chemistry education.

RECOMMENDATIONS

Recommendations for future research include selecting two different classes as research subjects acting as control and experimental groups to more objectively compare the effectiveness of the learning methods or strategies used on students' creative thinking skills. Additionally, future researchers can use variables other than creative thinking skills within lesson study practice.

ACKNOWLEDGEMENTS

We would like to thank the Teacher Professional Education (PPG) study program of the Postgraduate School of the State University of Malang for funding this activity.

BIBLIOGRAPHY

Asiyah, A., Topano, A., & Walid, A. (2021). Pengaruh Problem Based Learning (PBL) Terhadap Kemampuan Pemecahan Masalah dan Hasil Belajar Kognitif Siswa SMA Negeri 10 Kota Bengkulu. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, *3*(3), 717–727. https://doi.org/10.31004/edukatif.v3i3.263

Buzan, T., & Buzan, B. (2000). *The Mind Map Book: How to Use Radiant Thinking to Maximize Your Brain's Untapped Potential*. Plume.

Ceylan, Ö. (2022). The Effect of The Waste Management Themed Summer Program on Gifted Students' Environmental Attitude, Creative Thinking Skills and Critical Thinking Dispositions. *Journal of Adventure Education and Outdoor Learning*, *22*(1), 53–65. https://doi.org/10.1080/14729679.2020.1859393

Coenders, F., & Verhoef, N. (2019). Lesson Study: Professional Development (PD) for Beginning and Experienced Teachers. *Professional Development in Education*, *45*(2), 217–230.

Costa, A. L., & Presseisen, B. Z. (1985). *Glossary of Thinking Skills in A.L. Costa (ed). Developing Minds: A Resource Book For Teaching Thinking*. ASCD.

Effendy. (2016). *Ilmu Kimia untuk Siswa SMA dan MA Kelas X Jilid 1A Seri Bukuu Penunjang Pelaksanaan Pembelajaran Kimia Berdasarkan KTSP, Kurikulum 2013, dan Kurikulum Pembelajaran Kimia Lainnya*. Indonesian Academic Publishing.

Ernawati, M. D. W., Sudarmin, S., Asrial, A., Muhammad, D., & Haryanto, H. (2022). Creative Thinking of Chemistry and Chemistry Education Students in Biochemistry Learning through Problem Based Learning with Scaffolding Strategy. *Jurnal Pendidikan IPA Indonesia*, *11*(2), Article 2. https://doi.org/10.15294/jpii.v11i2.33842

Fitriani, L., Rahayu, S., & Nurlaelah, E. (2020). Pengaruh Mind Mapping terhadap Kemampuan Berpikir Kreatif Siswa dalam Pembelajaran Kimia. *Jurnal Pendidikan Sains Indonesia*, *8*(2), 135–142.

Fujii, T. (2019). Designing and Adapting Tasks in Lesson Planning: A Critical Process of Lesson Study. *Designing and Adapting Tasks in Lesson Planning: A Critical Process of Lesson Study*, 681–704.

González, G., & Deal, J. T. (2019). Using a Creativity Framework to Promote Teacher Learning in Lesson Study. *Thinking Skills and Creativity*, *32*(2), 114–128.

Guilford, J. P. (1956). The structure of intellect. *Psychological Bulletin*, *53*(4), 267–293. https://doi.org/10.1037/h0040755

Guilford, J. P. (1967). *The Nature of Human Intelligence*. McGraw-Hill.

Halim, A. (2022). Signifikansi dan Implementasi Berpikir Kritis dalam Proyeksi Dunia Pendidikan Abad 21 Pada Tingkat Sekolah Dasar. *Jurnal Indonesia Sosial Teknologi*, *3*(03), 404–418. https://doi.org/10.59141/jist.v3i03.385

Hsbollah, H. M., & Hassan, H. (2022). Creating Meaningful Learning Experiences with Active, Fun, and Technology Elements in The Problem-Based Learning Approach and its

Implications. *Malaysian Journal of Learning and Instruction*, *19*(1), Article 1. https://doi.org/10.32890/mjli2022.19.1.6

Jannah, M., Apriandi, D., & Andari, T. (2024). Pengembangan Media Pembelajaran Berbasis Google Site Interaktif untuk Meningkatkan Adversity Quotient Matematis Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *13*(1), 293–303. https://doi.org/10.24127/ajpm.v13i1.8330

Jia, X., Xu, T., & Zhang, Y. (2022). The Role of Metacognitive Strategy Monitoring and Control in the Relationship between Creative Mindsets and Divergent Thinking Performance. *Journal of Intelligence*, *10*. https://eric.ed.gov/?id=EJ1354130

Klopfer, L. E., & Aikenhead, G. S. (2022). Humanistic science education: The history of science and other relevant contexts. *Science Education*, *106*(3), 490–504. https://doi.org/10.1002/sce.21700

Mz, A. F. S. A., Rusijono, R., & Suryanti, S. (2021). Pengembangan dan Validasi Perangkat Pembelajaran Berbasis Problem Based Learning untuk Meningkatkan Keterampilan Berpikir Kreatif Siswa Sekolah Dasar. *Jurnal Basicedu*, *5*(4), Article 4. https://doi.org/10.31004/basicedu.v5i4.1260

Nuraini, S., & Hidayah, R. (2022). Profil Keterampilan Berpikir Kreatif Peserta Didik dan Media Pembelajaran yang Sesuai pada Materi Ikatan Kimia di SMA. *Prosiding Seminar Nasional Kimia (SNK)*, 85–95.

Ongowo, R. (2025). Creative Thinking in Science: Influence of Ethnicity, Gender and Grade Level in Co-educational Schools, Kenya. *Journal of Research in Education and Pedagogy*, *2*(1), Article 1. https://doi.org/10.70232/jrep.v2i1.17

Pane, R. M. (2022). Pendekatan Strategi Mind Mapping Dalam Pelajaran Sejarah Perkembangan Demokrasi Indonesia. *Education & Learning*, *2*(1), 16–21. https://doi.org/10.57251/el.v2i1.229

Pellegrin, L., Chassery, L., Bonnardel, N., Tong, C., Santi, V. P. D., Taxier, G., & Chaudet, H. (2019). Using Torrance Creative Thinking Criteria to Describe Complex Decision Making Outbreak Management by Public Health Expert. *IEA*, *3*, 50–59.

Prayudi, A., & Anggriani, A. A. (2022). Pengembangan Media Pembelajaran Interaktif Berbasis Web Menggunakan Google Sites untuk Meningkatkan Prestasi Belajar Siswa. *Jurnal Pendidikan Dan Media Pembelajaran*, *1*(1), Article 1. https://doi.org/10.59584/jundikma.v1i1.2

Sakir, N. A. I., & Kim, J. G. (2020). Enhancing Students' Learning Activity and Outcomes via Implementation of Problem-based Learning. *Eurasia Journal of Mathematics, Science and Technology Education*, *16*(12), em1925. https://doi.org/10.29333/ejmste/9344

Sani, R. A. (2015). *Pembelajaran Saintifik Untuk Kurikulum 2013*. PT. Bumi Aksara.

Seino, T., & Foster, C. (2021). Analysis of The Final Comments Provided by A Knowledgeable Other in Lesson Study. *Journal of Mathematics Teacher Education*, *24*(5), 507–528.

Sutrimo, S., Kamid, K., & Saharudin, S. (2019). LKPD Bermuatan Inquiry dan Budaya Jambi: Efektivitas dalam Meningkatkan Kemampuan Berpikir Kreatif Matematis. *IndoMath: Indonesia Mathematics Education*, *2*(1), 29. https://doi.org/10.30738/indomath.v2i1.3841

Syahrial, S., Asrial, A., Maison, M., Mukminin, A., & Kurniawan, D. A. (2020). Ethnoconstructivism analysis: Study of pedagogic mathematics competence of primary

school teachers. *International Journal of Evaluation and Research in Education (IJERE)*, *9*(3), 614. https://doi.org/10.11591/ijere.v9i3.20256

Tanti, T., Kurniawan, D. A., Sukarni, W., Erika, E., & Hoyi, R. (2021). Description of Student Responses Toward the Implementation of Problem-Based Learning Model in Physics Learning. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *6*(1), 30–38. https://doi.org/10.26737/jipf.v6i1.1787

Torrance, E. P. (1974). *Torrance Tests of Creative Thinking*. Ginn.

Ulfa, M., & Wijayanti, P. (2019). Profil Berpikir Kreatif Siswa Berkecerdasan Linguistik dan Siswa Berkecerdasan Logis-Matematis Smp dalam Menyelesaikan Masalah Matematika. *MATHEdunesa*, *8*(1), 14–20. https://doi.org/10.26740/mathedunesa.v8n1.p14-20

Vermunt, J. D., Vrikki, M., van Halem, M., Warwick, P., & Mercer, N. (2019). The Impact of Lesson Study Professional Development on The Quality of Teacher Learning. *Teaching and Teacher Education*, *81*, 61–73.

Viantri, C. A., & Asriningsih, T. M. (2016). Efektivitas Lesson Study pada Peningkatan Kompetensi Calon Guru Matematika. *Jurnal Matematika Dan Pendidikan Matematika*, *I*(1), 23–33.

Widiyono. (2021). *MIND MAPPING" Strategi Belajar yang Menyenangkan (E. Munastiwi & Ed) (eds.)*. Aksara.

Xu, S., Reiss, M. J., & Lodge, W. (2024). Enhancing scientific creativity through an inquiry-based teaching approach in secondary science classrooms. *International Journal of Science Education*, 1–18. https://doi.org/10.1080/09500693.2024.2419987