

Enhancing Chemistry Teaching Quality Through Case-Based Lesson Study

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Abstract

Improving the quality of learning in the Chemistry Learning Strategy course is essential to support students in developing the competencies needed to design and implement effective chemistry learning. The aim of the research is to improve the quality of learning in the Chemistry Learning Strategy course. The study was implemented in three cycles. The subjects were 37 third-semester students, assisted by seven observers who observed student activities. The research instrument was an observation sheet for learning quality, measured through student activity indicators: student enthusiasm in attending lectures, student interaction with lecturers, interaction between students, asking questions, answering questions, expressing opinions, group collaboration, student activities in groups, student participation in discussions, and student participation in concluding learning outcomes. The results showed that: 1) student learning activity increased by 18.61 percentage points from the initial condition to Cycle I, by 13.05 percentage points from Cycle I to Cycle II, and by 13.89 percentage points from Cycle II to Cycle III; 2) all indicators of student activity increased in each cycle, with the highest percentage in Cycle III for student activities in groups (94.44%) and the lowest for student participation in concluding learning outcomes (63.89%); and 3) in terms of quality, the category increased from MT (starting to be visible) to MM (starting to become a culture).

Keywords: case method, learning quality, lesson study, student activities

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1. Introduction

Education in the 21st century requires life skills in the form of competencies among students. Competence is a set of knowledge, skills, and behaviors that must be possessed by a person (Santagata et al., 2021; Agustini et al., 2020). These competencies can be developed when learning takes place effectively, thereby supporting the quality of learning. An important effort to achieve good-quality learning is to maximize the planning process and implement learning through practical, classroom-based research. According to Haryati et al. (2021), Iqbal et al. (2021), and Alanazi (2019), careful learning planning can

effectively support students in achieving learning competencies. This effort is not only intended to assess learning outcomes but also to analyze their impact on students as a form of reflection and follow-up. Uştuk and Costa (2021) stated that reflection activities can improve the quality of learning by informing subsequent activities.

On the other hand, in the development of the 2020–2024 Strategic Plan (Renstra) of the Ministry of Education and Culture, one of the targets is to improve the quality of learning and the relevance of higher education. In this context, higher education institutions (HEIs) are required to design and implement

innovative learning so that students can achieve optimal learning outcomes. For this reason, lecturers are required to be more creative and flexible in responding to the demands of the curriculum at their HEIs, particularly in the courses they teach. Among the many courses offered, Chemistry Learning Strategies is one course that must adapt to the demands of 21st-century education.

Chemistry Learning Strategies is one of the compulsory courses with a weight of three credits. The course provides a theoretical study of models, approaches, strategies, methods, and learning techniques that will be used during School Field Practice (PLP) and when students become teachers. Students learn about learning strategies, characteristics of chemistry learning, problem identification, exploration and determination of problem causes, and solutions using innovative learning models. Students also design innovative chemistry learning models and demonstrate them in microteaching activities. To develop critical, creative, and innovative thinking skills and problem-solving abilities, the course is designed using the case method. The case method is applied because concrete cases are often found in chemistry learning, such as low motivation, interest, or learning outcomes. Through these cases, students are encouraged to identify, investigate, and analyze problems, develop decision-making skills, and view problems and solutions from various perspectives through collaborative discussion.

The case method is a participatory learning approach based on discussion to solve cases or problems. Its application can hone and improve critical thinking skills (Fauzi et al., 2023), problem-solving skills (Mahdi et al., 2020; Wu et al., 2019; Chumak et al., 2022; Leggett & Smith, 2022; Ito & Takeuchi, 2021), communication skills, collaboration (Andayani et al., 2022; Khodijah et al., 2022; Fauzi et al., 2023), and creativity. According to Wijnia, L., et al. (2024), the case method is a learning design based on certain problems, events, or situations in which students are tasked with finding alternative solutions. In line with this, Fauzi (2023) found that the application of the

case method significantly improved students' critical thinking skills compared with conditions before treatment. In addition, Amelia (2024) reported that case-based learning can improve students' interpretation, analysis, evaluation, inference, explanation, and self-regulation skills as indicators of critical thinking. The case method is a strategy that can develop learning-related skills (Rosidah & Pramulia, 2021), build a democratic learning atmosphere, and encourage students to work together in expressing opinions, thereby making the learning atmosphere more enjoyable. Wijnia, L., et al. (2024) also revealed that learning by linking various cases to course material can make learning more effective and interesting.

Based on these scholarly perspectives, it can be concluded that implementing the case method extends beyond making material engaging and effective; it serves as a fundamental instructional design crucial for honing 21st-century competencies, specifically critical thinking, collaborative problem-solving, and independence in formulating alternative solutions.

When case method learning is applied to the Chemistry Learning Strategy course, it is expected to create meaningful learning that will ultimately improve the quality of learning. Nazgul et al. (2020) similarly stated that providing meaningful learning is something every educator should strive to achieve. When students learn something and find meaning in it, that meaning can become a reason to continue learning.

The case method in this study was implemented using the lesson study pattern. Lesson study is one approach for improving the quality of learning (Sairo, 2021; Laoli et al., 2022). Lesson study activities can be carried out by teachers and lecturers through collaboration with other lecturers or teachers in designing, observing, and reflecting on learning. Lesson study aims to support continuous professional development so that educators' professionalism can improve continuously. According to Hikamudin et al. (2023) and Bucher et al. (2024), lesson study is

a model of professional development through collaborative and continuous learning activities based on the principles of collegiality and mutual learning, while also building a learning community. Lesson study is implemented in three main stages: plan, do, and see (Chandler-Olcott et al., 2024).

The principles of collegiality and mutual learning are applied through collaboration so that no one feels superior or inferior, because all participants have the goal of learning from one another. This approach is intended to create an interactive, inspiring, enjoyable, challenging, and motivating learning process that encourages students to be active, creative, and independent according to their talents, thereby facilitating and deepening their understanding. Through lesson study, lecturers are required to design the learning environment and process so that the way students learn and understand can be manifested in active, collaborative, independent, and directed learning activities. Several studies on the implementation of lesson study to improve learning quality have been reported by Hikamudin et al. (2023), Bucher et al. (2024), and Winaryati et al. (2024).

The primary objective of implementing lesson study in this context is to create a collaborative and sustainable learning community among lecturers and students. Specifically, it facilitates and deepens student understanding by designing an inspiring, enjoyable, and challenging learning environment. It encourages active, independent, and creative student learning tailored to individual talents. It equips lecturers to function as strategic planners who can effectively design learning processes that realize student capabilities.

The novelty presented in this research concerns how the learning environment is conceptualized and managed, including a shift from teacher-centered learning to equal collaboration. It reduces traditional hierarchies by applying the principles of collegiality and shared learning. No one feels superior or inferior; instead, participants (lecturers and students) learn from one another as a team. Lecturers as learning designers are required to

go beyond simply delivering material by intentionally describing, designing, and implementing active and purposeful learning activities that recognize students' talents.

2. Research Method

2.1. Type of Research

This research is a quantitative descriptive study conducted using lesson study and the case method in lectures. Lesson study was carried out in three open classes (three cycles): Cycle I on September 26, 2022; Cycle II on October 3 and 10, 2022; and Cycle III on October 17 and 24, 2022. Each cycle consisted of three stages: plan, do, and see.

2.2. Research Subjects

The research was conducted among third-semester students who took the Chemistry Learning Strategy course, totaling 37 students. Seven observers also participated during the implementation of the open-class lesson study. The topics taught in the first, second, and third cycles, respectively, were exploration of the causes of problems in chemistry learning; analysis of discovery learning and problem-based learning models; and analysis of inquiry-based learning and project-based learning models.

2.3. Research Instruments

The instruments used were lesson plans, student worksheets, student learning activity observation sheets, and observation instruments for lecturers. The observed student activity indicators included student enthusiasm in attending lectures, student interaction with lecturers, interaction between students, asking questions, answering questions, expressing opinions, group collaboration, student activities in groups, student participation in discussions, and student participation in concluding learning outcomes.

2.4. Research Procedure

The research used a lesson study pattern divided into three stages in each cycle: plan, do, and see. In the plan stage, the lecturer team collaborated with the course teaching team to compile learning instruments in the

form of lesson plans and student activity assessment/observation sheets. The instruments were then applied in lectures in each cycle (do), while assigned observers observed lecturer and student activities during the implementation of the case method. At the end of each cycle, reflection (see) was conducted involving the observers and model lecturers, and the results were used to improve the next cycle. Before implementing the case method, initial measurements were conducted to establish baseline student conditions. The first open class involved assignments to explore problems in chemistry learning through direct school observations and interviews with teachers and students. The cases found were discussed in groups, with the same procedure followed in Cycles II and III. Cycle I was conducted in one meeting, whereas Cycles II and III were conducted in two meetings each. More details are presented in Figure 1.

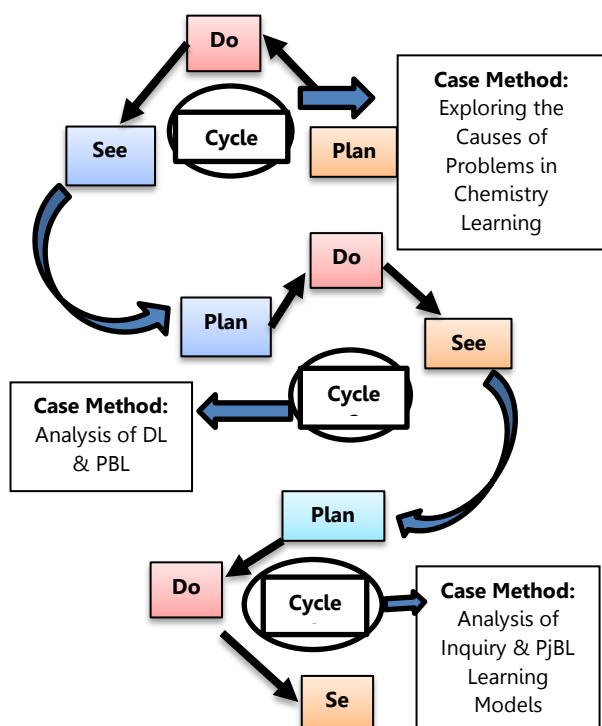


Figure 1. Flow of implementation of case method-based lesson study in the chemistry learning strategy course

2.5. Data Analysis Techniques

The observation data were analyzed descriptively and quantitatively by calculating

the percentage achieved for each indicator. The resulting percentages were classified into four categories: BT (0–25%), MT (26–50%), MB (51–75%), and MK (76–100%), following the classification applied by Susriani and Inawati (2020). These categories were interpreted as follows: BT, *Not Yet Visible*, indicating that students have not yet demonstrated initial signs of the behavior specified in the indicator; MT, *Starting to Be Visible*, indicating that initial signs of the behavior have begun to emerge but are not yet demonstrated consistently; MB, *Starting to Develop*, indicating that students have shown increasingly clear signs of the expected behavior and are beginning to demonstrate it consistently; and MK, *Becoming Habituated*, indicating that students consistently demonstrate the expected behavior across learning activities.

3. Result and Discussion

The results of the analysis of observer observation data during the implementation of the case study-based lesson method conducted in three cycles showed that there was a change in the quality of the chemistry learning strategy course in the classroom. The recapitulation of the results of observer observations related to the quality expressed in the percentage of student learning activity in the Chemistry Learning Strategy course in each cycle is presented in Figure 2.

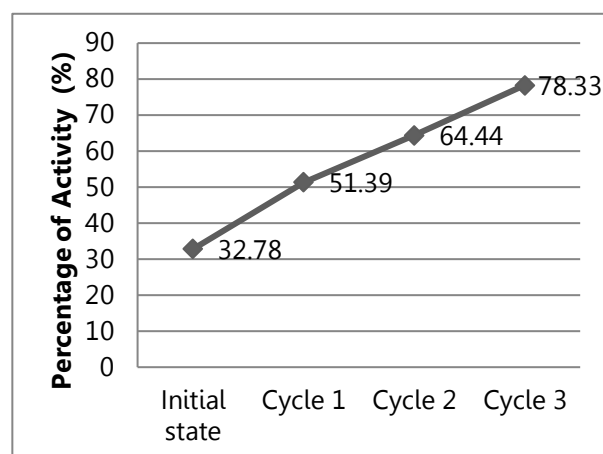


Figure 2. Graph of the Percentage of Student Learning Activity in the Chemistry Learning Strategy Course

Figure 2 shows that there is an increase in the percentage of student learning activities in the chemistry learning strategy course in each cycle. Cycle I experienced an increase of 18.61%, cycle II by 13.05%, and cycle III by 13.89% from the initial state. Based on the figure, it can also be seen that the quality of students at the beginning of learning related to the measured indicators is in the MT

category (starting to be seen), and after the implementation of the case method-based lesson study, there has been a change to the MM category (starting to become a culture). Furthermore, to see the fluctuations in changes in student learning activities in chemistry learning strategy lectures in each learning quality indicator for each cycle, more details can be seen in Table 1.

Table 1. Student Learning Activities in Chemistry Learning Strategy Lectures

No	Indicator	Cycle							
		N	%	N	I (%)	N	II (%)	N	III (%)
1	Student enthusiasm in attending lectures	15	41.67	20	55.56	25	69.44	32	88.89
2	Student interaction with lecturers	10	27.78	18	50.00	20	55.56	24	66.67
3	Interaction between students	12	33.33	20	55.56	23	63.89	28	77.78
4	Asking	10	27.78	10	27.78	23	63.89	27	75.00
5	Answering	13	36.11	18	50.00	24	66.67	26	72.22
6	Expressing opinions	15	41.67	22	61.11	25	69.44	28	77.78
7	Group collaboration	12	33.33	25	69.44	28	77.78	30	83.33
8	Student activities in groups	13	36.11	20	55.56	24	66.67	34	94.44
9	Student participation in discussions	10	27.78	15	41.67	20	55.56	30	83.33
10	Student participation in concluding learning outcomes	8	22.22	17	47.22	20	55.56	23	63.89
Average Percentage of student activity (%)			32.78		51.39		64.44		78.33

Table 1 shows that student learning activities for all indicators increased in each learning cycle when the case method was implemented. This is indicated by the increasing number of students participating in all indicators. In Cycle I, the highest percentage was for group collaboration (69.44%), while the lowest was for asking questions (27.78%). In Cycle II, the highest percentages were for student enthusiasm in attending lectures and expressing opinions (69.44%), while the lowest percentages were for student interaction with lecturers, student participation in discussions, and student participation in concluding learning outcomes (55.56%). In Cycle III, almost all students participated in all indicators. The highest activity was observed for student activities in groups (94.44%), while the lowest was for student participation in concluding learning outcomes (63.89%).

The visualization of the activity summary for each learning quality indicator is presented in Figure 3. Figure 3 shows an increase in the percentage of student learning activities in the Chemistry Learning Strategy course in each cycle for each indicator. In Cycle III, all indicators of student learning activities reached a percentage of more than 60%. The highest percentage was for student activities in groups (94.44%), while the lowest was for student participation in concluding learning outcomes (63.89%). These results indicate that student activity can be increased through the case method.

The highest activity was observed for student activities in groups. This may be because each group member was given a task and responsibility to find and solve the cases assigned to their respective groups. For example, for the first topic, which concerned

exploring the causes of problems in chemistry learning in schools, each group was required to enter a class to observe chemistry teachers while teaching and students while learning. In addition, interviews were conducted with students and teachers. This assignment was carried out at different schools for each group. The assignment to find real cases in the field triggered the enthusiasm of each individual to participate in expressing ideas or thoughts related to the cases obtained. This is in line with Andayani et al. (2022) and Wospakrik et al. (2020), who stated that the case method can provide a complex and contextual learning experience because students can relate phenomena observed in the field to the material without simply memorizing content, while understanding the relationship between the material taught and real-world situations. This statement is also reinforced by Mahdi et al. (2020) and Wu et al. (2019), who stated that the case method can develop cognitive abilities and rational, accessible, and systematic problem-solving skills.

On the other hand, the student enthusiasm indicator also experienced a significant increase, with the second-highest value. This may be because the case method applied in learning encourages students to seek as much information as possible related to the cases they will solve, especially because the cases reflect real situations and are therefore more interesting to study. When learning is interesting, it can increase students' interest and motivation. They try to provide input and ideas as solutions to the cases they want to solve. This finding is supported by Sartania et al. (2022), who found that case-based learning involving contextualized and collaborative discussion enhanced student engagement, participation, knowledge integration, and learning outcomes. The results of research by Sobri et al. (2021) also revealed that the case method can influence students' interests, motivation, and learning outcomes.

Recent studies have shown that the case method enhances students' critical thinking and decision-making abilities by engaging them in the analysis of authentic problems, exploration of multiple alternatives, and

selection of the most feasible solution rather than merely identifying correct or incorrect answers (Supardi & Rahman, 2025; Safitri et al., 2026). In this study, students try to make decisions and collaborate with other students in their groups to solve the assigned case. This condition encourages students to participate in interactive discussions. They not only produce individual analysis but they will also observe and evaluate the contributions of their peers. They can consider changing their views based on the analysis and insights provided by other students. More capable students are challenged to solve cases and must determine for themselves what their decisions are and what alternatives are feasible. This condition promotes a deeper and more integrated understanding of knowledge application. Contemporary research suggests that collaborative problem-solving activities foster cognitive and social interactions that facilitate the development of shared mental models, collective intelligence, and socially shared regulation of learning. Through these interactions, learners construct knowledge both at the intraindividual level, through personal reflection and reasoning, and at the interindividual level, through negotiation, communication, and collaborative decision-making. Consequently, teamwork not only enhances problem-solving performance but also strengthens critical thinking, knowledge integration, and higher-order cognitive processes (Hadwin et al., 2018; Salas et al., 2018; Westby & Riedl, 2022; Huang et al., 2025).

The results of this study show that, in the case method, students are required to think analytically and generalize the cases that occur. Collaboration and active participation of each member greatly determine the generalizations produced. This finding is consistent with recent studies demonstrating the effectiveness of case-based learning in promoting active and meaningful learning. Sartania et al. (2022) found that collaborative case-based learning increased student participation, constructive discussion, engagement, knowledge integration, and academic performance. Similarly, Zhang et al. (2023) reported that student-centered case-

based teaching enabled students to actively construct knowledge, connect theoretical concepts with practical applications, consider multiple perspectives, and develop higher-order thinking, analytical, and synthesis skills. Stronger evidence is provided by Bayona and Durán (2024), whose meta-analysis showed that the case method was more effective than traditional lectures in promoting cognitive learning outcomes, particularly knowledge acquisition and skill development. More

recently, Zou et al. (2026) confirmed through a systematic review and meta-analysis that case-based learning significantly enhanced students' problem-solving abilities. Collectively, these findings suggest that the use of contextual cases, active discussion, and collaborative problem solving can facilitate deeper knowledge construction and strengthen students' understanding and application of the material being learned.

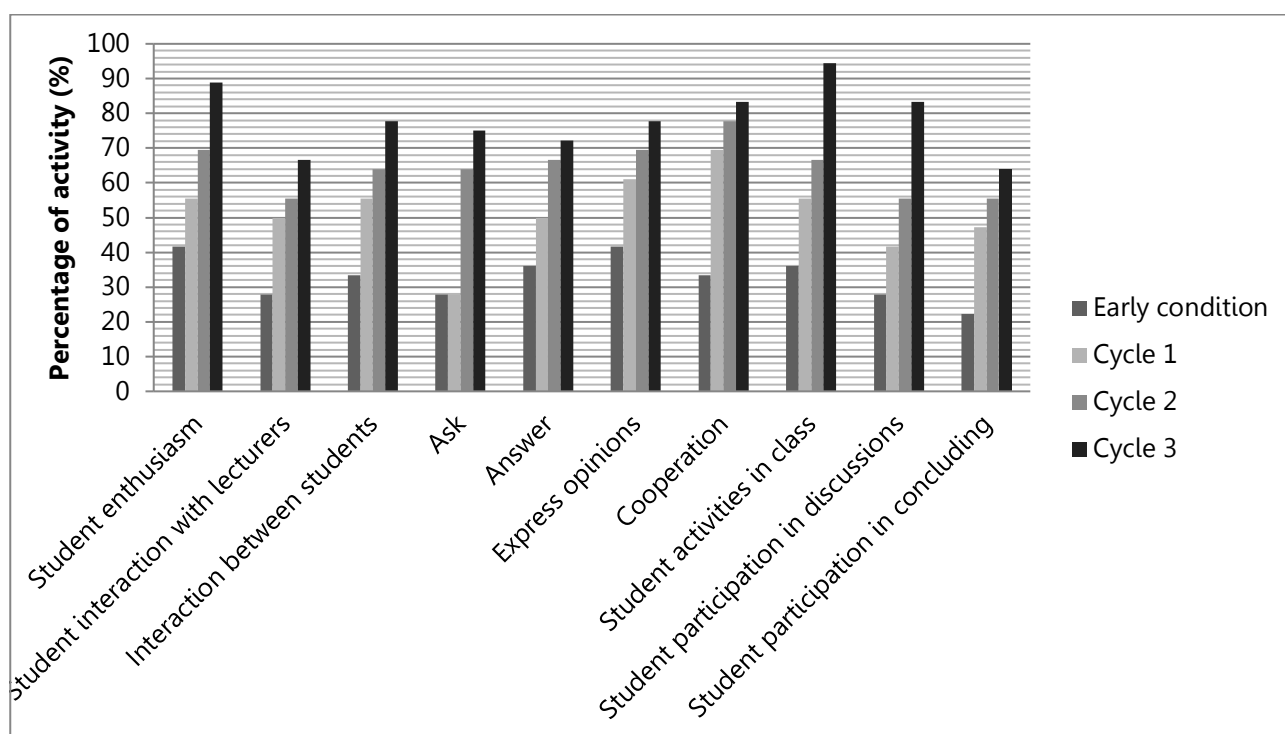


Figure 3. Graph of the Percentage of Student Learning Activity in the Chemistry Learning Strategy Course in each Indicator

The second advantage of the case method is its potential to change behavior, particularly in terms of the quality of knowledge and its application. The quality of knowledge is improved because students gain a better understanding of when and how to use knowledge. As a result, students learn how to apply knowledge through case analysis, experiencing its use as participants rather than merely hearing about it in the abstract. The application of improved knowledge rests on the fact that each individual must work with others. An individual's knowledge is valuable to the extent that others can benefit from it. Debate skills can be developed through class discussions, as reflected in the group activity

indicator, which reached 94.44% in Cycle III. Presentation skills can be developed through classroom presentations of cases, small-group work skills can be developed through case analysis in small groups, as reflected in the student participation in discussion indicator, which reached 83.33% in Cycle III, and workload-management skills can be developed by giving students limited time to prepare cases.

The results of this research are also relevant to the findings of Varma et al. (2025), who reported that case-based learning becomes more effective when students are actively involved in collaborative discussions and

communicate their solutions through presentations. Discussion activities encourage students to analyze problems from various points of view, build arguments, and negotiate meaning with peers, while presentations facilitate reflection, communication, and knowledge sharing. Through this process, students not only deepen their conceptual understanding but also develop critical thinking, teamwork, and communication skills that are essential in the 21st-century learning environment. Active participation in discussion also provides opportunities for students to clarify their ideas and respond to different perspectives during the learning process. Presenting solutions further encourages students to organize their thoughts and explain the reasoning behind the solutions they propose. These results are also in line with Sobri et al. (2021), who found that learning with the case method can improve the quality of learning among students. The findings indicate that the case method can provide a learning environment that supports active participation, interaction, and deeper learning.

The results of this study also indicate that the quality of learning can be improved when the learning environment is appropriately designed by the lecturer. The character category, once it has begun to become a culture, should not decline again, as indicated by the increasing number of students demonstrating the activity indicators: student enthusiasm in attending lectures, student interaction with lecturers, interaction between students, asking questions, answering questions, expressing opinions, group collaboration, student activities in groups, student participation in discussions, and student participation in concluding learning outcomes. These indicators therefore need to be maintained and further improved.

4. Conclusion

Based on the results of the data analysis, it can be concluded that student activity can be improved through the application of case method-based lesson study: 1) the percentage of student learning activities in the Chemistry

Learning Strategy course increased in each cycle; 2) all indicators of student activity increased in percentage in each cycle, with the highest percentage in Cycle III for student activities in groups (94.44%) and the lowest for student participation in concluding learning outcomes (63.89%); and 3) in terms of quality, the category increased from MT (starting to be visible) to MM (starting to become a culture).

The study offers several suggestions. For the student activity indicator with the lowest percentage, "student participation in concluding learning outcomes," teachers are recommended to introduce a structured synthesis framework or a simple concept map at the end of the case study to support students in summarizing and organizing the chemical concepts they have learned in the next cycle. Meanwhile, for the activity with the highest percentage, "group collaboration," teachers can take advantage of this strong group dynamic by asking highly active groups to take turns presenting their final conclusions and briefly explaining the reasoning behind them to the class. Future research could examine abstract chemistry courses, such as Physical Chemistry or Organic Chemistry, to verify the broader effectiveness of the approach across different chemistry learning contexts.

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