Enhancing Students' Learning Outcomes through Cooperative Learning: A Classroom Action Research

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Article Info

Article history:

Received Aug 2, 2025
Revised Sep 29, 2025
Accepted Nov 20, 2025
OnlineFirst Dec 25, 2025

Keywords:

Chemical Bonding
Cooperative Learning
Greetings and Questions
Learning Completion

ABSTRACT

Purpose of the study: This study aimed to examine the effectiveness of cooperative learning using the greeting and questioning technique in achieving students' mastery of chemistry learning outcomes on the topic of chemical bonding.

Methodology: The study employed classroom-based action research conducted in several instructional cycles. Data were collected using achievement tests, classroom observations, and documentation. Achievement tests were administered to measure students' learning outcomes, while observations were used to monitor teacher performance and student engagement throughout the learning process. Documentation supported the collection of contextual data related to the school, teachers, and students. Data analysis focused on the percentage of students achieving mastery learning criteria across cycles.

Main Findings: The results revealed a progressive improvement in students' mastery learning across instructional cycles. Classical mastery increased from 42.5% prior to the intervention to 47.5% in Cycle I, 72.5% in Cycle II, and reached 87.5% in Cycle III. These findings indicate that cooperative learning with the greeting and questioning technique effectively enhanced students' learning outcomes and enabled the achievement of classical mastery in chemical bonding material.

Novelty/Originality of this study: This study provides empirical evidence on the effectiveness of a cooperative learning strategy integrating greeting and questioning activities in improving mastery learning in chemistry, particularly on abstract topics such as chemical bonding, thereby contributing practical insights to classroom-oriented chemistry instruction.

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1. INTRODUCTION

Chemistry is a fundamental science that plays an important role in developing students' scientific understanding and problem-solving skills [1], [2]. One of the core topics in senior secondary chemistry is chemical bonding, which serves as a foundation for understanding molecular structure, chemical reactions, and material properties [3], [4]. However, chemical bonding is widely recognized as an abstract topic that often poses significant learning difficulties for students, particularly when instruction relies heavily on teacher-centered approaches and symbolic representations [5], [6].

Previous studies have shown that students frequently experience misconceptions and low learning achievement in chemical bonding due to its abstract nature and the limited opportunity to actively construct knowledge during instruction [7], [8]. Conventional teaching methods tend to emphasize memorization rather than conceptual understanding, resulting in low student engagement and unsatisfactory learning outcomes [9], [10]. These challenges indicate the need for instructional strategies that actively involve students in the learning process and promote meaningful interaction among learners [11], [12].

Cooperative learning has been widely acknowledged as an effective instructional approach for enhancing student engagement, interaction, and learning outcomes [13], [14]. By organizing students into small groups and encouraging collaboration, cooperative learning provides opportunities for learners to exchange ideas, ask questions, and clarify misunderstandings [15], [16]. One cooperative learning strategy that emphasizes interaction and active participation is the greeting and questioning technique, which encourages students to exchange questions and responses in a structured yet engaging manner [17], [18]. This technique allows students to actively process learning content while simultaneously developing communication skills.

Despite the growing body of research on cooperative learning in chemistry education, empirical studies specifically examining the application of the greeting and questioning technique in teaching chemical bonding remain limited. Most existing studies focus on general cooperative learning models without exploring specific interaction-based techniques that foster both cognitive engagement and mastery learning [19], [20]. Consequently, there is a need for classroom-based research that investigates how this technique can support students in achieving learning mastery, particularly in abstract chemistry topics.

Based on these considerations, this study aims to examine the effectiveness of cooperative learning using the greeting and questioning technique in improving students' mastery of chemistry learning outcomes on the topic of chemical bonding. The findings of this study are expected to contribute practical insights for chemistry teachers regarding the implementation of cooperative learning strategies that promote active participation, conceptual understanding, and mastery learning in secondary chemistry classrooms.

2. RESEARCH METHOD

2.1. Research Design

This study employed classroom action research aimed at improving students' chemistry learning outcomes through the implementation of cooperative learning using the greeting and questioning technique. The research was conducted in iterative instructional cycles consisting of planning, action, observation, and reflection stages [21], [22]. This design was selected to allow continuous improvement of instructional practices while systematically monitoring students' learning progress.

2.2. Research Subjects

The subjects of this study were 40 senior secondary school students enrolled in a chemistry class studying the topic of chemical bonding. The participants were selected through total sampling, as all students in the class were involved in the research. The class represented a heterogeneous group in terms of academic ability, which allowed the researcher to observe the effectiveness of the instructional intervention across varying levels of student performance [23], [24].

2.3. Instruments and Data Collection Techniques

Data were collected using achievement tests, observation sheets, and documentation [25], [26]. The achievement tests were administered at the end of each instructional cycle to measure students' mastery of chemical bonding concepts. Observation sheets were used to monitor teacher performance and student engagement during the learning process, focusing on participation, collaboration, and responsiveness during cooperative activities. Documentation was employed to collect supporting data related to school profiles, student characteristics, lesson plans, and learning materials used throughout the research [27], [28].

To ensure the relevance of the data collected, the instruments were developed based on the learning objectives and indicators of chemical bonding concepts. The alignment between research variables, data sources, and instruments is presented in Table 1.

Table 1. Research Instrument Grid

No.	Research Variable	Indicator	Instrument	Data Type
1	Students' learning outcomes	Understanding of chemical bonding concepts	Achievement test	Quantitative
2	Students' learning engagement	Participation in cooperative activities	Observation sheet	Qualitative
3	Teacher performance	Implementation of cooperative learning steps	Observation sheet	Qualitative

4	Learning process documentation	Lesson plans, student lists, learning materials	Documentation	Qualitative

2.4. Data Analysis Techniques

Data analysis was conducted using descriptive quantitative and qualitative techniques [29], [30]. Quantitative data obtained from achievement tests were analyzed by calculating the percentage of students who achieved the predetermined mastery learning criterion. Classical mastery learning was considered achieved if at least 85% of students met the minimum mastery threshold. Qualitative data from observations were analyzed descriptively to identify changes in student engagement and teacher performance across instructional cycles. The results of each cycle were compared to evaluate improvements and inform subsequent instructional planning.

2.5. Research Procedures

The research was carried out through three instructional cycles, each consisting of four stages: planning, action, observation, and reflection [31], [32]. During the planning stage, lesson plans and learning materials based on cooperative learning with the greeting and questioning technique were prepared. The action stage involved the implementation of the planned instructional activities in the classroom. Observations were conducted simultaneously to record student engagement and teacher performance. Finally, the reflection stage involved analyzing the results of each cycle to identify strengths and areas for improvement, which were then used to refine the instructional strategy for the next cycle.

3. RESULTS AND DISCUSSION

The research results obtained and data analyzed in this study were student learning achievement from the learning process before the intervention, the learning process before the intervention, and the learning process with the intervention using the cooperative learning model with the greeting and question technique. The analyzed research results presented include individual student learning achievement and class learning achievement, as well as observations of teacher and student activities during the learning process. Initial learning was conducted without the implementation of the cooperative learning model with the greeting and question technique. Observations without the use of the greeting and question technique were conducted by completing teacher and student observation sheets according to the prepared and implemented outcome indicators. Subsequently, in the following meeting, the researcher conducted the learning process using the greeting and question technique for three meetings, with three cycles.

Based on observations of teacher activities during the pre-intervention period, 28.75% of teachers carried out activities in accordance with the observation sheets, while 71% did not carry out the activities listed on the observation sheets. More teachers did not carry out the activities listed on the observation sheets than did the activities listed on the observation sheets, from the beginning of the learning activity to the end of the learning activity. From the results of observations of student activities in the pre-action, 50% of students carried out the activities listed on the observation sheet, while 50% did not. Students preferred to listen to the explanation of the lesson material delivered by the teacher. Then work on the Student Worksheet provided by the teacher, after completing the Student Worksheet, students summarized the lesson material. Then students took a test at the end of the lesson.

Based on the pre-action learning mastery test data, the average student learning outcome was 61.75, with only 18 students completing the individual learning achievement and 22 students failing to complete it. Meanwhile, the classical learning mastery score, 42.5%, was not achieved. Because the classical mastery standard is ≥ 75%, the first meeting without implementing the cooperative learning model using the greetings and questions technique did not achieve classical learning mastery. Therefore, the researcher continued to Cycle I with the implementation of the cooperative learning model using the greetings and questions technique.

Based on observations of teacher activities in Cycle I, 64.29% of teachers carried out the activities listed on the observation sheet, while 35% did not carry out the activities listed on the observation sheet. Teachers carried out the activities listed on the observation sheet using the cooperative learning model using the greetings and questions technique. However, several activities remained incomplete. Observations of student activity in Cycle I revealed that 75% of students completed the activities listed on the observation sheet, while 25% did not. Students began actively participating in learning activities using the cooperative learning method. However, some activities remained incomplete.

Based on the Chemistry Learning Completion Test data from Cycle I, the average student learning outcome was 63.5, with only 19 students completing the individual tasks and 21 students failing to complete the individual tasks. Meanwhile, the classical learning completion rate (47.5%) was not achieved. Because the classical completion standard is 75% or higher, the researcher continued to Cycle II to ensure students achieved chemistry learning completion. Observations of teacher activity in Cycle II revealed that 85.71% of teachers completed the activities listed on the observation sheet, while 14.29% did not complete the activities listed on the observation sheet. Teachers implemented the activities listed on the observation sheet using the cooperative learning model, using the greeting technique. However, several activities remained incomplete.

Observations of student activity in Cycle II revealed that 87.5% of students completed the activities listed on the observation sheet, while 12.5% did not. Students began actively participating in learning activities using the cooperative learning method. However, some activities remained incomplete. Based on the Cycle II chemistry learning completion test data, the average student learning outcome was 69.25, with only 29 students completing the activities individually and 11 students not completing them individually. Meanwhile, the classical learning completion rate, 72.5%, had not been achieved. Because the classical learning completion standard is ≥75%, the researcher continued to Cycle III to ensure students achieved chemistry learning completion.

Observations of teacher activity in Cycle III revealed that 100% of teachers completed the activities listed on the observation sheet, while 0% did not complete the activities listed on the observation sheet. Teachers implemented the activities listed on the observation sheet using the cooperative learning model of the greeting technique. Observations of student activity in Cycle III revealed that 100% of students completed the activities listed on the observation sheet, while 0% did not. Students actively participated in learning activities using the cooperative learning method.

Based on the Cycle III chemistry learning completion test data, the average student learning outcome was 77.75, with 35 students completing the task individually and 5 students failing to complete the task individually. Meanwhile, the classical learning completion rate was 87.5%. Because classical completion had reached 75%, the fourth meeting (Cycle III), which implemented the cooperative learning model of greetings and questions, was discontinued. The achievement of student learning completion on the topic of chemical bonds was due to the use of the greetings and questions learning model in the teaching and learning process. By using the greetings and questions learning model, students became more active. Furthermore, the greetings and questions learning technique engaged students in working collaboratively in small groups.

Student completion scores from the pre-action cycle to cycle III showed significant improvement. This can be seen in the following graph:

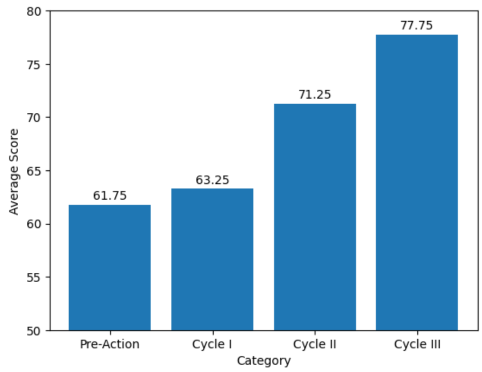

Figure 1. Graph of Average Improvement in Student Learning Outcomes

The average student learning outcome before the intervention was 61.75, in Cycle I it was 63.25, in Cycle II it was 71.75, and in Cycle III it was 77.75. The results indicate that after the implementation of the cooperative learning model, using the greeting and question-asking technique, there was an increase in each cycle.

In the learning process without the intervention, interaction between teachers and students was suboptimal, with only a few asking questions and responding to the material presented by the teacher. During the pre-intervention, interaction between teachers and students slightly improved from before Cycle I and continued to improve through Cycle III. This occurred due to discussions using the cooperative learning model, using the greeting and question-asking technique. By implementing the cooperative learning model, students were actively involved. Cooperative learning using the greeting and question-asking technique is a form of cooperative learning where the characteristics of cooperative learning make students more active and provide group rewards, thus motivating students to achieve better results. One characteristic of cooperative learning is the presence of group rewards, which motivates each student to achieve better results.

Research results from cycles I to III revealed that some students' individual completion scores declined. This was due to a lack of understanding of the questions. Furthermore, the questions differed from cycles I to III, with varying levels of difficulty. Students perceived the questions in cycle I as easier than those in cycles II and III.

The results of the classical student learning obtained indicate that after the implementation of the cooperative learning model with greeting and question-taking techniques, and at each cycle change, the classical learning completion rate increased. This can be seen in the following graph:

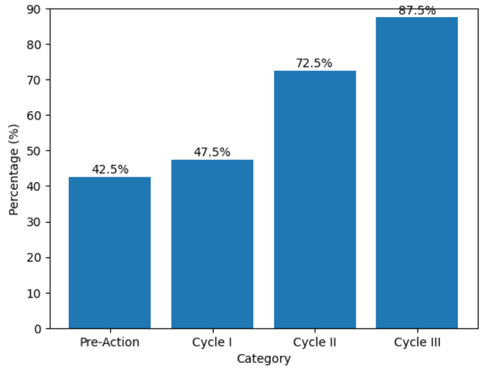

Figure 2. Graph of Classical Learning Completion Improvement

The classical learning completion before the action was 42.5%, in cycle I it was 47.5%, in cycle II it was 72.5%, and in cycle III it was 87.5%. From the classical learning results, it can be seen that after the implementation of the cooperative learning model, the technique of sending greetings and questions at each cycle change experienced an increase.

The findings of this study suggest that cooperative learning using the greeting and questioning technique supports meaningful learning in chemistry, particularly for abstract topics such as chemical bonding. The observed improvement in students' learning outcomes indicates that structured peer interaction enables learners to actively construct knowledge rather than passively receive information. Through the exchange of questions and responses, students were encouraged to articulate their understanding, confront misconceptions, and refine their conceptual frameworks.

From a theoretical perspective, these findings align with social constructivist learning theory, which emphasizes the role of social interaction in knowledge construction. Cooperative learning environments provide opportunities for students to engage in dialogue, negotiate meaning, and co-construct understanding through shared cognitive processes [33], [34]. The greeting and questioning technique appears to function as a scaffold that prompts students to engage cognitively and socially, thereby supporting deeper conceptual processing in chemistry learning.

The effectiveness of this instructional approach may also be attributed to its ability to enhance student engagement and motivation. By incorporating structured questioning activities, the learning process became more interactive and student-centered [35], [36]. Students were not only required to respond to questions but also to generate and exchange questions with peers, which likely increased their sense of responsibility for learning. This active involvement can reduce learning anxiety and foster a more supportive classroom climate, both of which are essential for learning complex scientific concepts [37], [38].

Furthermore, the gradual improvement observed across instructional cycles suggests that repeated exposure to cooperative learning routines helps students adapt to collaborative learning norms. As students become more familiar with cooperative roles and expectations, they are better able to focus on conceptual understanding rather than procedural aspects of group work. This finding highlights the importance of consistency and structured implementation when applying cooperative learning strategies in chemistry classrooms.

Despite the overall positive impact of the instructional intervention, the findings also imply that cooperative learning alone may not address all learning challenges [39], [40]. Abstract concepts in chemical bonding often require multiple representations, including symbolic, submicroscopic, and macroscopic explanations [41]-[43]. Therefore, integrating cooperative learning with visual representations and explicit conceptual scaffolding may further enhance its effectiveness [44]-[46]. This consideration points to the need for instructional designs that combine social interaction with representational support. Overall, this study contributes to the growing body of research supporting cooperative learning in science education by demonstrating the pedagogical value of the greeting and questioning technique. The findings suggest that this approach can serve as a practical and effective strategy for improving conceptual understanding and mastery learning in secondary chemistry education, while also fostering positive classroom interactions.

The findings of this study have important pedagogical implications for chemistry instruction at the secondary level. The gradual increase in learning completion to classical completion demonstrates that cooperative learning using the greeting and questioning technique impacts not only students' cognitive aspects but also the quality of the learning process [47], [48]. This model encourages two-way and multi-directional interactions in the classroom, so that students no longer act as passive recipients of information but rather as active subjects involved in the construction of knowledge. This is particularly relevant for learning chemical bonds, which require in-depth conceptual understanding and the ability to connect various chemical representations.

From the perspective of developing 21st-century skills, the application of the greeting and questioning technique also contributes to improving students' communication skills, collaboration, and courage in expressing opinions [49], [50]. The question-and-answer activity in small groups creates a more inclusive and supportive learning environment, allowing previously passive students to become more confident in engaging in discussions [51], [52]. This impact demonstrates that the learning model used is not only effective in improving learning outcomes but also supports the development of students' social and affective aspects, which are essential in science learning.

Another implication of this research is the increased professionalism of teachers in managing active learning. The increase in teacher activity observation scores from pre-action to cycle III indicates that teachers have become more skilled in designing, implementing, and reflecting on cooperative learning. Thus, this study provides empirical evidence that classroom action research can serve as a means of continuously developing teachers' pedagogical competence, particularly in implementing student-centered learning strategies.

Despite showing positive results, this study has several limitations that require consideration. First, the study was conducted in only one class with a relatively limited number of subjects, so generalizing the results to other school contexts or other subjects requires caution. Student characteristics, school culture, and teachers' initial competencies can influence the effectiveness of implementing this learning model.

Second, this study focused on improving cognitive learning outcomes as measured by a learning completion test, while the impact on students' affective aspects and science process skills has not been analyzed in depth using standardized instruments. Furthermore, variations in the difficulty level of the questions in each cycle have the potential to influence comparisons of learning outcomes between cycles, although a general upward trend remains visible. Third, this study did not integrate the use of visual media or multiple representations, which are theoretically crucial in learning about chemical bonds. Therefore, the improvement in learning outcomes could potentially be further enhanced if cooperative learning were combined with the use of visual media, simulations, or integrated macroscopic, submicroscopic, and symbolic representation approaches.

Based on these limitations, further research is recommended to involve a broader range of subjects, combine cooperative learning with chemical representation strategies, and explore their impact on students' critical thinking skills and scientific attitudes. This way, the contribution of the greeting and questioning learning model to chemistry learning can be more comprehensively understood.

4. CONCLUSION

This study concludes that the implementation of cooperative learning using the greeting and questioning technique effectively enhances students’ mastery of chemical bonding concepts. The instructional approach contributed to progressive improvements in students’ learning outcomes and successfully achieved the predetermined criteria for classical mastery. These findings indicate that structured cooperative interaction plays an important role in supporting students’ conceptual understanding of abstract chemistry topics.

In addition to improving learning outcomes, the application of this cooperative learning technique fostered greater student engagement and motivation during the learning process. Students became more actively involved in classroom discussions, demonstrated increased willingness to ask and respond to questions, and participated more confidently in collaborative activities. Overall, the results suggest that the greeting and questioning technique is a practical and effective instructional strategy for promoting active learning and mastery achievement in secondary chemistry education.

ACKNOWLEDGEMENTS

The researcher would like to express his deepest gratitude to all parties who have helped in this research.

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