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The Effectiveness of Collaborative Learning in Chemistry: An Analysis of Students' Perceptions, Self-Confidence, and Motivation

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Abstract

The urgency of this research lies in the pressing need to gain an in-depth understanding of how collaborative learning, particularly through group work and presentations, influences students' self-efficacy and motivation within the context of 21st-century chemistry education. This study examined students' perceptions of collaborative learning in chemistry, specifically group work and presentations, and explored their relationship to self-efficacy and motivation. This study employed a mixed-methods design. The participants consisted of 30 first-year undergraduate students enrolled in an introductory chemistry course. They were selected using a convenience sampling technique. The main instrument used in this study was a questionnaire. Data analysis was carried out in two complementary stages, namely quantitative analysis and qualitative analysis. Descriptive statistics showed that students' overall perceptions of collaborative learning were quite positive, with a mean score of 3.69 on a 5-point scale. Among the five dimensions, interaction and collaboration (M = 3.74) and fairness and accountability (M = 3.73) received the highest ratings, while presentation (M = 3.53) received the lowest. The perception scale demonstrated good reliability with a Cronbach's Alpha of 0.82. Thematic analysis of qualitative responses revealed that group work was perceived as beneficial for understanding complex material through peer explanations, but challenges such as uneven contributions and limited preparation time persisted. Students' self-efficacy increased with adequate preparation and mastery of the material, but was often hampered by nervousness and fear of making mistakes during presentations. Motivation was found to stem from intrinsic factors, such as curiosity and interest in chemistry, as well as extrinsic factors, including grades, recognition, and classroom atmosphere. Students also provided constructive suggestions for improving collaborative learning, such as clearer role assignments, more structured guidance, and fairer assessments. These findings suggest that while collaborative learning in chemistry has great potential, its effectiveness depends on addressing organizational and psychological aspects.

Keywords: *Collaborative Learning, Chemistry Education, Student Perception, Self-Confidence, Learning Motivation*

Introduction

21st-century science education emphasizes not only the transmission of knowledge but also the development of critical thinking, scientific communication, and collaborative skills. Chemistry, as a discipline rich in abstract representations from the microscopic structure of matter to quantitative reasoning often poses challenges for first-year students (Hasibuan et al., 2021). In this context, collaborative learning, particularly in the form of group work followed by class presentations, becomes increasingly relevant (Nwafor et al., 2023). Such practices

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integrate the social construction of meaning with scientific communication, enabling students to combine conceptual understanding with the metacognitive competencies necessary for sustained chemistry learning (Petrescu et al., 2018). Active engagement through collaborative learning strategies not only strengthens students' critical thinking skills (Qi et al., 2024) but also supports effective scientific discourse in a peer-supported environment (Szozda et al., 2024). Furthermore, the integration of innovative pedagogical approaches, such as project-based learning, can further enhance the collaborative learning experience by contextualizing chemical concepts in real-world scenarios (Herranen et al., 2021).

This multifaceted approach encourages students to engage deeply with the subject matter, thereby fostering a more comprehensive understanding of chemistry (Aliev et al., 2023). In a way theoretical, learning collaborative rooted in constructivism social, where knowledge built through interaction, negotiation meaning and elaboration cognitive (Curşeu et al., 2017). Group discussions encourage students to articulate reasoning, align mental models, and identify misconceptions (Chen et al., 2023). Presentations require synthesis, clarity of argument, and readiness to respond to peers' questions, which can enhance understanding. In chemistry (Lim et al., 2022), this format is particularly valuable for strengthening understanding of topics such as stoichiometry, chemical bonding, and acid-base theory, which require flexible transitions between macroscopic, microscopic, and symbolic representations. Thus, group work and presentations serve not only as teaching techniques but as vehicles for conceptual internalization and scientific literacy (Wester, 2020). Engaging in a collaborative environment allows students not only to develop critical thinking skills but also to enhance their communication and teamwork abilities, which are essential in chemistry (Roemintoyo et al., 2022).

Furthermore, the integration of small group discussion methods into the curriculum has demonstrated effectiveness in fostering deeper understanding and retention of complex scientific concepts (Handayani et al., 2021; Ramnanan & Pound, 2017). Collaborative learning is not automatically effective. Challenges such as stowaways, uneven assignment distribution, or shallow discussions can undermine its quality (Susanti et al., 2019). Presentations can also trigger anxiety, especially among first-year students still adjusting to verbally articulating scientific arguments (Pyo, 2023). Diverse academic backgrounds can broaden the range of preparedness, leading some students to report benefits from peer support, while others may feel their contributions are overlooked (Pelch, 2018). This complexity highlights the importance of student perceptions how they interpret fairness, support, benefits, and challenges as a key factor in explaining why collaborative strategies succeed in some cases and fail in others (Pelch, 2018). Specific aspects of anxiety associated with collaborative learning, particularly during presentations, can significantly impact student performance and engagement. Understanding these dynamics is crucial for developing effective teaching strategies that encourage collaboration and individual contributions in academic settings (Patil & Aithala, 2017).

Two psychological constructs are central to this: academic self-efficacy and motivation to learn. Self-efficacy influences students' willingness to actively engage, answer questions, and persist in solving challenging problems (Gorghiu et al., 2024). Motivation whether intrinsic (curiosity, intellectual satisfaction) or extrinsic (grades, career prospects, recognition) guides effort and persistence in learning (Nisar, 2025). Positive perceptions of group work and presentations are expected to increase self-confidence (through successful shared experiences and peer feedback) and motivation (through relevance, engagement, and social support). Conversely, negative experiences can diminish both, thereby reducing the effectiveness of collaborative learning (Ehiemere & Chikezie, 2025). A relevant observation in the literature

highlights that self-efficacy is a significant predictor of academic outcomes, suggesting that enhancing students' self-confidence can lead to improved performance in academic settings (Abdelrahman, 2020). Furthermore, the interplay between intrinsic and extrinsic motivation illustrates the complexity of student engagement, where intrinsic factors are often correlated with higher academic resilience and achievement (Dokhykh, 2021; Liu et al., 2019). Understanding how these psychological constructs interact in collaborative learning environments is crucial for fostering an atmosphere conducive to effective learning (Syed Husain et al., 2025).

English: A significant research gap remains in the literature on active learning in STEM, as many studies prioritize cognitive outcomes without adequately addressing emotional and motivational factors such as perceptions and self-efficacy among first-year chemistry students. This gap is noted in the context of the interconnected nature of these constructs (Yussop et al., 2021). Furthermore, existing research often isolates group work or presentations, rather than analyzing these components collaboratively within an integrated framework (Harris et al., 2020). Furthermore, comprehensive instruments to assess the effectiveness of engagement, interaction, fairness, and presentation practices alongside psychological variables are rarely detailed in a single study (Sudiro et al., 2022). The literature emphasizes the importance of creating environments conducive to cognitive and affective engagement, stating that understanding student perceptions can improve outcomes in collaborative settings (Yufrizal, 2021). Thus, combining group learning methods with an emphasis on student collaboration and supportive teaching strategies is crucial to maximizing learning experiences in STEM disciplines (Särchen et al., 2022; Taylor et al., 2022).

The novelty of this study lies in three aspects: (a) its integrative focus on students' perceptions of group work and presentations as core elements of collaborative learning, which is crucial in understanding how students interact within this framework; (b) its systematic linkage of these perceptions with self-efficacy and learning motivation, thus mapping potential pathways explaining the effectiveness of collaborative learning in chemistry, where self-efficacy significantly contributes to academic persistence and achievement; (c) its contextual emphasis on first-year students, who are in a critical transition phase from secondary school learning to higher education a transition that is often fraught with challenges as students adjust to new academic expectations (Alzubi et al., 2024). These findings are expected to provide practical implications for instructional design, particularly in structuring group assignments, assigning roles, implementing feedback mechanisms, and ensuring fair assessment so that collaborative learning enhances self-efficacy and motivation, which have been shown to increase student engagement and satisfaction in the learning environment (Evangelista & Thrower, 2023; Ismail et al., 2020).

This study aims: (1) to describe students' perceptions of group work and presentations in chemistry classes; (2) to map their levels of self-confidence and motivation; (3) to analyze the relationship between perceptions of collaborative learning and self-confidence; (4) to analyze the relationship between perceptions of collaborative learning and motivation; (5) to assess the relative contributions of self-confidence and motivation to the perceptions of collaborative learning effectiveness; and (6) to identify potential differences based on prior characteristics (e.g., presentation experience, frequency of group work). Thus, the research questions that guided this study were: (a) What are students' perceptions of group work and presentations in chemistry classes? (b) What are students' levels of self-confidence and motivation? (c) Is there a significant relationship between perceptions of collaborative learning and self-confidence? (d) Is there a significant relationship between perceptions of collaborative learning and motivation?

(e) To what extent do self-confidence and motivation contribute to explaining perceptions of collaborative learning effectiveness? and (f) Are there differences in findings based on students' prior characteristics?

Method

Research Design

This study employed a mixed-methods design with a dominant quantitative component complemented by qualitative exploration. The quantitative component focused on students' perceptions of collaborative learning in chemistry through a structured questionnaire, while the qualitative component explored students' self-efficacy and motivation through open-ended questions. This combination was chosen because perceptions can be systematically measured using a Likert scale, while self-efficacy and motivation are more nuanced and easier to understand through students' own narratives. Participants consisted of 30 first-year undergraduate students enrolled in an introductory chemistry course. They were selected using convenience sampling techniques because they were directly involved in collaborative learning activities such as group work and class presentations. Participation was voluntary, anonymous, and did not affect students' grades. Informed consent was obtained from all respondents.

Instrument

The main instrument used in this study was a questionnaire specifically developed to capture students' perceptions of collaborative learning, their academic self-efficacy, and their motivation in learning chemistry. The instrument was designed in two parts: a quantitative part and a qualitative part. The quantitative part consisted of a 16-item Likert-type scale with five response categories, ranging from "Strongly Disagree" to "Strongly Agree." These items were structured to reflect four important aspects of collaborative learning: effectiveness, interaction and collaboration, fairness and accountability, and the role of presentations and discussions. Through these items, students were asked to evaluate how group work and class presentations contributed to their understanding of chemistry concepts, how fair and balanced the group process was, and how much the class discussion after the presentation helped them clarify misunderstandings.

The qualitative section was designed as an open-ended questionnaire to explore students' experiences in greater depth. Rather than using fixed scale items, self-confidence and motivation were examined through several guiding questions that encouraged students to express their feelings and reflections. For example, students were asked how they felt when presenting group work in chemistry class, what factors increased or decreased their self-confidence, what typically motivated them to actively participate in group work and presentations, and how these activities influenced their enthusiasm for learning chemistry. This format was chosen to allow for the emergence of themes that might not be captured in structured scales, thus giving students the freedom to share their authentic experiences.

Data Collection Procedures

Data was collected through a Google Form distributed to students mid-semester, ensuring all participants had sufficient exposure to group work and presentation activities. Respondents were asked to complete Likert-scale items first, followed by open-ended questions. On average, completion took approximately 10–12 minutes.

Data Analysis

Data analysis in this study was conducted in two complementary stages: quantitative and qualitative analysis. The quantitative analysis focused on students' perceptions of collaborative learning, as measured using a Likert scale. Responses to 16 items were first checked for completeness, then negatively worded items were reverse-coded so that higher scores consistently indicated more positive perceptions. The data were then analyzed descriptively to obtain mean scores, standard deviations, and distribution patterns for both the overall perception scale and each of its dimensions: effectiveness, interaction and collaboration, fairness and accountability, and presentation and discussion. Reliability analysis using Cronbach's alpha was also conducted to ensure that the scale items had acceptable internal consistency and were suitable for further interpretation.

The qualitative analysis focused on students' self-confidence and motivation, which were explored through open-ended questions. Responses were analyzed thematically by reading all narratives, identifying key statements, and coding recurring ideas. The codes were then grouped into broader categories, such as factors that enhance self-confidence, sources of anxiety or doubt, intrinsic motivations such as curiosity and interest, and extrinsic motivations such as grades or recognition. From these categories, key themes were developed that represented the students' collective experiences. Representative quotes from students' responses were used to illustrate each theme and provide a voice for their perspectives. Findings from both analyses were integrated into the discussion. The quantitative results provided an overview of how students perceived collaborative learning in chemistry, while the qualitative findings enriched this understanding by revealing the personal meanings, challenges, and driving factors behind their self-confidence and motivation. This integrative approach ensured that the research not only presented numbers but also captured the depth of students lived experiences in collaborative learning environments.

Results

This section presents the research findings, which are divided into two main parts: quantitative and qualitative results. The quantitative analysis focuses on students' perceptions of collaborative learning in chemistry, measured using Likert-scale items. It includes descriptive statistics to illustrate students' perception levels across various dimensions, a reliability test using Cronbach's Alpha to confirm the internal consistency of the perception scale, and a summary of overall perception scores. These results provide a clear overview of how students evaluate collaboration, fairness, and engagement in group work and presentations. The qualitative analysis explores students' self-efficacy and motivation through open-ended responses. It identifies key themes such as the benefits of peer collaboration for understanding complex concepts, challenges like unequal participation and presentation anxiety, and the role of preparation in building confidence. Motivation was found to arise from both intrinsic curiosity and extrinsic factors like grades and recognition. Students also suggested clearer role distribution, structured guidance, and fairer assessments to enhance collaborative practices.

Descriptive Statistics of Student Perception

Descriptive statistics of students' perceptions of collaborative learning in chemistry, grouped into five indicators, are presented in Table 1. The table displays the mean scores and standard deviations for each indicator, reflecting the general trends and variations in students' responses.

***Table** 1Deviation of Student Perceptions Based on Indicators*

Indicator	Means	Development Standard
Effectiveness	3.67	0.67
Interaction & Collaboration	3.74	0.65
Justice & Accountability	3.73	0.75
Presentation	3.53	0.79
Discussion	3.68	0.70

As shown in Table 1, all indicators scored above the midpoint of the scale (3.0), indicating that students generally viewed group work and presentations positively. Among the five indicators, "Interaction & Collaboration" obtained the highest average score, while "Presentation" recorded the lowest score, although still within a fairly positive range.

Experience with Group Presentations

Students were also asked to report how many times they had participated in group presentations. This information provides a general overview of respondents' experience with collaborative activities prior to this course. The distribution of their experience is illustrated in Figure 1.

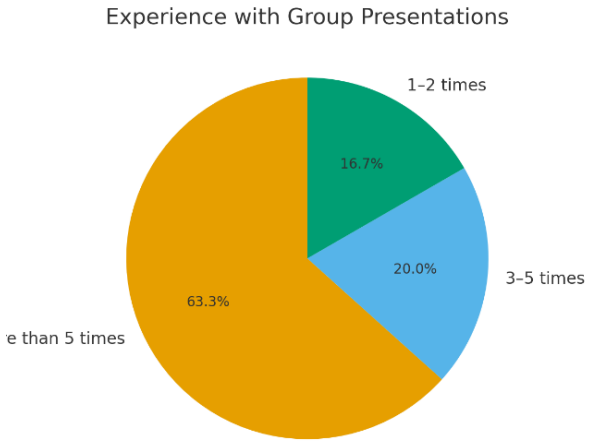

***Figure 1.** Experience with Group Presentations*

As shown in Figure 1, the majority of students had experienced group presentations between once and twice, while a small proportion reported more frequent experiences (three to five or more times). Only a small number of students stated that they had never presented in a group. This distribution indicates that most respondents had engaged in collaborative presentation tasks before, although the intensity of these experiences varied across groups.

Reliability of the Perception Scale

The reliability of the perception scale was evaluated using the Cronbach's alpha coefficient to determine the internal consistency of the instrument. As presented in Table 2, the 16-item perception scale yielded a Cronbach's alpha value of 0.82, which falls within the category of high reliability, indicating that the items within the instrument consistently measure the same underlying construct. This level of reliability suggests that the scale provides stable and dependable results when used to assess students' perceptions of collaborative learning in chemistry. Furthermore, a Cronbach's alpha value above 0.80 is generally considered acceptable in educational and psychological research, signifying that the instrument possesses adequate psychometric properties. Therefore, the perception scale used in this study can be regarded as a valid and reliable tool for

capturing students' attitudes, experiences, and evaluations of collaborative learning practices in the chemistry classroom.

Table 2. *Reliability of the Perception Scale*

Scale	The amount of goods	Cronbach's Alpha
Perception Learning Collaborative	16	0.82

As presented in Table 2, a Cronbach's Alpha value of 0.82 indicates that the perception scale has a high level of reliability. This means that the items in the scale are internally consistent and measure the same underlying construct. In other words, students' responses to the 16 items are coherent, making the scale reliable for measuring their perceptions of collaborative learning in chemistry.

Overall Perception Level

Table 3. *Average Overall Student Perception Score*

Scale	The amount of goods	Overall Average (1–5)
Perception Learning Collaborative	16	3.69

As presented in Table 3, the overall mean score of 3.69 indicates that students' perceptions of collaborative learning in chemistry can be categorized as quite positive. This finding highlights hat, on average, students view group work and presentations as beneficial to their learning experience, although some aspects may require further refinement to maximize effectiveness. While the quantitative results provide a general overview of students' perceptions of collaborative learning, they do not fully capture the underlying reasons for these perceptions. To complement the statistical findings, qualitative data from open-ended questions were analyzed thematically. This analysis offered deeper insights into students' personal experiences, the challenges they faced, the factors influencing their self-confidence, and their sources of motivation and suggestions for improving group work and presentations. The following section presents these qualitative findings.

Experiences and Challenges in Collaborative Learning

Students generally described positive experiences from participating in group work and presentations. Many emphasized that they understood the material better when peers explained it in their own words, and that presentations helped them remember and organize concepts systematically. For example, one student stated, *"I can learn from my friends who explain the material more clearly*." Another student commented, *"When the presenter is able to explain the material well, it is easier for me to follow and understand."* Despite these benefits, students also identified several challenges. Common issues included uneven contributions among group members, limited preparation time, and difficulty responding to unexpected questions. One student shared, *"When assignments were assigned, only two out of five members actually contributed*," while another admitted, *"Speaking in front of the class made me nervous, and I often forgot what I wanted to say."* These challenges reflect organizational and affective barriers to fully effective collaboration.

Confidence in Group Work and Presentations

Open-ended responses revealed a variety of feelings about presentation confidence. Students reported greater confidence when they had mastered the material, received support from group members, or had adequate preparation beforehand. For example, one student stated, *"I feel confident when I understand the material and the audience is paying attention."* Another student emphasized, *"Preparing before the presentation makes me more confident*

speaking in front of the class." On the other hand, a recurring theme was anxiety, particularly the fear of making mistakes or not being able to answer questions. One student noted, *"Speaking in front of the class can make me nervous and make me lose focus*." These statements indicate that confidence is situational and depends on individual preparedness and the classroom atmosphere.

Motivation and Suggestions for Improvement

Students identified intrinsic and extrinsic factors that motivated them to participate in group work and presentations. Intrinsic motivation included curiosity about the material and a desire to deepen understanding, while extrinsic motivation stemmed from grades, peer recognition, and the classroom environment. For example, one student commented, *"If the material is interesting, I feel more motivated to actively participate*," while another admitted, *"I want to get good grades and improve my skills."*

In terms of improvement, students provided constructive suggestions to lecturers. These suggestions included clearer assignment instructions, ensuring a more equitable distribution of roles, providing relevant resources or references, and creating a more interactive classroom environment. As one student recommended, *"Lecturers should provide clear objectives and guidelines for each presentation,"* while another suggested, *"Make group discussions more engaging so that presentations are not just a formality."*

Table 4. *Qualitative Analysis of Students' Experiences, Self-Confidence, and Motivation.*

Theme	Information	Example Quote
Experience and Challenges	Student generally feel Work groups and presentations beneficial For understand material, but take notes problem like participation that is not evenly, time preparation limited, and difficult handle questions that are not unexpected.	"I can Study from friends I 'll explain material with more clear" / "When the distribution task, only two of the five members actually contribute ."
Confidence	Self-confidence increases when students master the material, prepare well, or feel supported by their peers. However, many still feel nervous and afraid of making mistakes during presentations.	"I feel confident when I understand the material and the audience is paying attention." / "Speaking in front of a class can cause nervousness and make me lose focus."
Motivation and Advice	Students are motivated by both intrinsic (curiosity, deeper understanding) and extrinsic (grades, recognition, classroom environment) factors. They suggest clearer instructions, fairer role allocation, better resources, and more interactive classroom management.	"If the material is interesting, I feel more motivated to participate actively." / "The lecturer should provide clear objectives and guidelines for each presentation."

As shown in Table 4, the thematic analysis identified three key themes regarding students' experiences with collaborative learning in chemistry. First, students viewed group work and presentations as helpful for understanding but noted issues like unequal participation and presentation anxiety. Second, self-confidence was tied to preparation and material mastery, though fear of mistakes persisted. Third, motivation stemmed from both intrinsic and extrinsic factors, with students suggesting improvements for collaborative activities. These insights complement the quantitative findings by explaining students' generally positive perceptions of collaborative learning.

Discussion

Overall Perception of Collaborative Learning

The findings of this study indicate that overall student perceptions of collaborative learning in chemistry were moderately positive, with a mean score of 3.69 (see Table 3). This indicates that students generally appreciated group work and presentations as learning methods. Scores above the midpoint (3.0) indicate that collaborative learning was not only tolerated but also considered beneficial to their understanding of chemistry. These results align with previous studies in science education, which have shown that cooperative and collaborative learning strategies promote engagement and improve academic outcomes. Moderately positive ratings also indicate areas for improvement. Students did not report very high levels of satisfaction, suggesting that collaborative learning has not fully met their expectations or maximized its potential.

This finding is supported by research showing that while collaborative learning can enhance understanding, it may still fall short in meeting students' specific needs, leading to varying levels of satisfaction (Fitriana, 2023; Pyo, 2023). The complexity of chemistry as a subject requiring multiple levels of representation (macroscopic, microscopic, symbolic) may explain why students still experience challenges despite positive perceptions. Research suggests that the multifaceted nature of a subject like chemistry requires well-targeted teaching strategies to effectively facilitate understanding and engagement (Karande et al., 2018).This complexity highlights the importance of designing collaborative activities that specifically address the cognitive demands of chemistry learning. Furthermore, students' experiences of anxiety during collaborative tasks can significantly impact their overall engagement and satisfaction, as noted in studies on academic anxiety (Patil & Aithala, 2017; Susanti et al., 2019). For example, oral presentation anxiety has been identified as a common challenge that can hinder student performance and interaction in group settings, emphasizing the need for instructional support focused on managing such anxiety (Khusnia, 2017; Ortega-Donaire et al., 2023).

Creating an anxiety-reducing environment can foster better collaboration and increase positive perceptions of group work, suggesting that careful attention should be paid to both the cognitive and emotional aspects of collaborative learning in chemistry education (Pelucio et al., 2022). The results of this study provide evidence that perceptions of collaborative learning cannot be viewed in isolation. Student evaluations are shaped by prior experiences, individual self-efficacy, and motivational factors, all captured through open-ended responses. Thus, the relatively positive overall scores are best understood as a result of both cognitive benefits and affective barriers coexisting in the classroom context.

Dimensions of Perception

When broken down into five dimensions (see Table 1), the analysis revealed significant variation in student evaluations. *Interaction and collaboration* received the highest mean score (M = 3.74, SD = 0.65), indicating that students highly valued the opportunity to exchange ideas, solve problems together, and receive feedback from peers. This finding aligns with the social constructivist perspective, which emphasizes that learning is a socially mediated process. Similarly, *fairness and accountability* received positive scores (M = 3.73, SD = 0.75), indicating that most students perceived the distribution of roles and responsibilities within their groups as fair, although qualitative data indicated that unequal participation remained a concern for some students.

The effectiveness dimension also received a relatively positive score (M = 3.67, SD = 0.67), indicating that students believed group work helped them understand difficult chemistry concepts and retain the material more effectively. This was supported by qualitative statements such as, *"I can learn from my friends who explain the material more clearly*." These comments reinforce the quantitative evidence that students view group work as a meaningful supplement to traditional instruction. In contrast, *presentations* received the lowest mean score (M = 3.53, SD = 0.79). Students stated that while presentations were helpful in summarizing concepts, the activity was sometimes perceived as a mere formality. This, coupled with nervousness and anxiety during public speaking, reduced the perceived value of presentations. The *discussion dimension*, however, received a slightly higher score (M = 3.68, SD = 0.70), indicating that while formal presentations were less preferred, the subsequent interactive discussions were perceived as more beneficial. Together, these findings underscore the need to improve presentation practices to reduce anxiety and increase meaningful engagement.

Instrument Reliability

To ensure the robustness of the perception scale, a reliability analysis was conducted. As reported in Table 2, Cronbach's Alpha for the 16-item perception scale was 0.82. This value exceeds the recommended threshold of 0.70, indicating good internal consistency. Practically, this means that the items coherently measure the same underlying construct students' perceptions of collaborative learning. The instrument's high reliability strengthens confidence in the quantitative findings. It indicates that the observed patterns in mean scores across the five dimensions are not random but rather reflect consistent trends in student responses. Without a reliable instrument, any interpretation of the results could be questioned. Thus, the high alpha coefficient strengthens the credibility of subsequent discussions and provides a solid foundation for integrating quantitative and qualitative insights. Furthermore, the consistency of responses also reflects students' shared experiences in the same educational context. Although individual differences are evident in the qualitative data, the fact that the instrument demonstrated high internal consistency indicates that core perceptions of collaborative learning are relatively stable across the sample of 60 students. This suggests that these findings are not simply idiosyncratic but represent a general pattern in how students evaluate collaborative learning in chemistry.

Experiences and Challenges in Collaborative Learning

The qualitative findings provided further depth to the quantitative results. As summarized in Table 4, students reported that group work improved their understanding of chemistry concepts, particularly when peers explained the material in simpler terms. One student commented, *"When the presenter is able to explain the material well, it's easier for me to follow and understand."* This experience confirms the relatively high scores for *effectiveness* and *interaction* in Table 1, which highlight the importance of peer explanations and collaboration. At the same time, challenges were a recurring theme.

Students expressed frustration with uneven contributions, with some members dominating tasks while others remained passive. As one response put it, *"When the tasks were divided, only two out of five members actually contributed."* This aligns with the quantitative results, where fairness and accountability scored positively overall but with a relatively high standard deviation (SD = 0.75), indicating variability in experiences. In other words, while many students perceived group work as fair, others still struggled with the issue of stowaways. Another frequently mentioned challenge was presentation anxiety. Several students acknowledged that presenting in front of peers caused anxiety, which caused them to lose focus or forget material.

This aligns with findings in the literature describing the impact of anxiety on performance, particularly in educational contexts involving public speaking (Prentiss, 2021; Theriana, 2023). The relatively low mean score on the presentation dimension (M = 3.53) may reflect this difficulty, as presentation anxiety has been shown to negatively impact students' ability to convey information effectively and maintain engagement throughout the presentation (Pressley et al., 2021). Thus, the qualitative data illuminate why students, despite finding value in collaboration, are less enthusiastic about presentations, underscoring the need for instructional support in managing performance anxiety. Research suggests that structured instructional strategies can significantly reduce anxiety symptoms associated with public speaking by fostering a supportive classroom environment and providing effective coping mechanisms (Bajri & Hago Elmahdi, 2024).

For example, implementing guided practices such as visualization, preparation techniques, and creating a low-pressure atmosphere encourages students to develop the confidence necessary to present willingly and competently. Furthermore, providing social support within the educational environment has also been noted to reduce anxiety and improve overall presentation outcomes. Collectively, these insights highlight the critical need for educators to integrate anxiety management strategies into their teaching practices, ensuring students feel more prepared and confident when engaging in collaborative presentations.

Confidence in Group Work and Presentations

The second qualitative theme focused on self-confidence. Students described feeling confident when they were well-prepared, had mastered the material, or felt supported by their peers. For example, one student stated, *"I feel confident when I understand the material and the audience is paying attention."* This perspective aligns with the generally positive attitudes reflected in the *interaction and collaboration dimension* in Table 1, which suggests that self-confidence is closely related to preparation and group dynamics. However, a lack of self-confidence was also frequently reported. Nervousness, fear of making mistakes, and difficulty answering unexpected questions all undermined students' self-confidence.

As another student explained, *"Speaking in front of the class can make me nervous and make me lose focus."* These experiences explain the lower scores for *the presentation dimension* and highlight psychological barriers that can limit the effectiveness of collaborative learning. Overall, these findings suggest that self-confidence in collaborative environments is conditional. Self-confidence increases with preparation, mastery, and a supportive environment, but decreases under pressure or when roles are unclear. Therefore, any effort to enhance collaborative learning must address both structural (task design, fairness) and psychological (self-confidence, anxiety management) dimensions simultaneously.

Motivation in Collaborative Learning

The third qualitative theme relates to student motivation. As shown in Table 4, both intrinsic and extrinsic motivators influenced participation. Intrinsically, students cited curiosity, interest in the material, and learning satisfaction. One student wrote, *"If the material is interesting, I feel more motivated to actively participate."* Extrinsically, students were motivated by the desire for good grades, recognition from peers and the instructor, and the overall classroom atmosphere. This aligns with self-determination theory, which states that learning motivation is influenced by internal desires and external rewards. Quantitative results support this interpretation. Although motivation was not directly measured in Likert-type items, its influence can be inferred from the relatively high scores in effectiveness and discussion. These dimensions indicate that students

are motivated to engage when they see clear benefits to their understanding and when discussions are interactive and meaningful. Research shows that student engagement is closely related to academic achievement, with motivated students tending to perform better due to their active involvement in the learning process and the perceived relevance of the tasks (Hidayat et al., 2023; Rodríguez et al., 2019). Furthermore, research has shown that motivation can stimulate curiosity and emotional investment in learning materials, thereby increasing overall engagement and task completion (Anuyahong & Pengnate, 2023; Jian, 2022).

Qualitative findings confirm that motivation is a crucial driver of positive perceptions. Elements such as perceived competence and enjoyment, which are essential for fostering intrinsic motivation, play a significant role in how students engage with learning activities. For example, environments that meet basic psychological needs, such as autonomy and competence, have been correlated with increased student motivation and engagement (Wood, 2019; Yu et al., 2020). Indeed, when students perceive their contributions as meaningful and their learning as enjoyable, their motivation to participate increases, thereby enhancing student engagement and satisfaction in the educational context. Students also offered practical suggestions for improving motivation and overall effectiveness. These included clearer instructions from instructors, fairer role assignments, and more engaging class discussions. As one student recommended, *"Instructors should provide clear objectives and guidelines for each presentation."* These suggestions not only highlight areas for improvement but also demonstrate that students are active stakeholders in shaping the learning process.

Integration of Quantitative and Qualitative Findings

The integration of quantitative and qualitative findings yields a nuanced understanding of student experiences. Quantitatively, students expressed quite positive perceptions of collaborative learning, with interaction and collaboration rated highest and presentations lowest (see Table 1). Qualitatively, these assessments were explained by student narratives: they valued learning from peers but felt hampered by uneven participation and nervousness during presentations. The instrument's reliability (Cronbach's Alpha = 0.82; see Table 2) ensures that these results are credible and not an artifact of measurement error. Furthermore, the overall perception score (M = 3.69; see Table 3) indicates a generally positive trend, while the themes summarized in Table 4 reveal the personal experiences behind these numbers. Together, these provide a holistic picture of collaborative learning in chemistry.

Figure 1 complements these findings by showing that most students had at least some prior experience with group presentations. This contextual factor helps explain why perceptions were generally positive, but not entirely positive: although students were not entirely new to collaborative tasks, their experiences varied in frequency and quality. Previous studies have highlighted the impact of prior collaborative experiences on students' engagement and confidence in the learning environment. For example, project-based learning (PBL) has been shown to improve student motivation and learning outcomes by connecting academic content to real-world problems, thus enabling a more meaningful educational experience.(Firmansyah et al., 2024; Fitzgerald & Palincsar, 2024).

Integration of evidence This show that although learning collaborative useful, its effectiveness is very dependent on management justice, building trust yourself, and grow motivation. According to the work of Lechler and Huemann, when student consider contribution they valuable and understanding objective effort collaborative they, motivation intrinsic they For involved in tasks the increase (Henry et al., 2018; Lechler & Huemann, 2023). Furthermore,

creating an environment that recognizes individual competence and encourages collective success can further enhance the collaborative learning experience (Mentzer et al., 2017).

Conclusion

This study aimed to investigate students' perceptions of collaborative learning in chemistry, focusing on group work and presentations, and to explore how these experiences relate to their self-confidence and motivation. Quantitative results indicated that students' overall perceptions were quite positive (M = 3.69), with *interaction and collaboration* rated highest and *presentations* lowest. The perception scale also demonstrated good reliability (Cronbach's Alpha = 0.82, see Table 2), confirming that the instrument consistently measured students' views. Further qualitative findings revealed that while group work enhanced understanding through peer explanations, challenges such as unequal contributions and presentation anxiety diminished its effectiveness. Students also described their self-confidence as conditional increasing with preparation and mastery but decreasing under pressure and reported that motivation stemmed from intrinsic curiosity and extrinsic factors such as grades and recognition.

These results suggest that collaborative learning is a valuable teaching approach for chemistry, but its success depends heavily on addressing psychological barriers and organizational issues. This study advances the body of knowledge by integrating quantitative and qualitative insights, demonstrating that perceptions are shaped not only by cognitive benefits but also by affective and motivational dimensions. However, these findings should be interpreted with caution due to several limitations. The sample size was relatively small (N = 30) and was drawn from a single institution, which limits the generalizability of the results. Furthermore, self-reported data may be biased, and open-ended responses, while rich, cannot capture the full range of experiences across contexts. For future research, it is recommended that studies be expanded to larger and more diverse samples to increase the generalizability of the findings. Longitudinal designs can be used to examine how perceptions, confidence, and motivation develop over time as students gain more experience in collaborative learning.

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