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STUDENTS' PERCEPTIONS AND LEARNING EXPERIENCES IN A STEM FOUNDATION CHEMISTRY COURSE: A PRE–POST SEMESTER ANALYSIS

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Abstract

Understanding students' learning experiences in foundational STEM courses is important for supporting effective pedagogical practices. This study explored changes in students' perceptions and learning experiences in a Malaysian foundation chemistry course using a pre–post survey design conducted over one academic semester. A researcher-developed questionnaire, informed by previous studies in STEM and chemistry education, was administered at the beginning and end of the semester. The instrument included identical quantitative sections designed to examine students' attitudes, learning difficulties, and learning strategies throughout the course. The pre-semester findings indicated that students initially experienced anxiety related to chemistry learning, particularly in calculation-based topics, alongside a reliance on memorization-based learning strategies. Comparisons with the post-semester findings suggested several observable changes in students' perceptions and learning experiences. While some academic challenges remained throughout the semester, students reported lower levels of nervousness and generally positive perceptions toward the teaching and classroom environment. The findings also suggested changes in students' learning preferences and study approaches over time. Qualitative feedback further highlighted the importance of clear explanations, supportive teaching approaches, repeated practice, and interactive learning opportunities in supporting students' learning experiences. Overall, the findings suggest that supportive instructional practices and structured learning environments may contribute positively to students' engagement and perceptions in foundation-level chemistry courses.

Keywords: foundation chemistry, student attitudes, chemistry learning anxiety, active learning, pre–post survey

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Introduction

A nation's capacity for innovation and economic growth is increasingly tied to the strength of its Science, Technology, Engineering, and Mathematics (STEM) education. Recognizing this imperative, Malaysia has established the advancement of STEM as a national priority, as outlined in the Malaysia Education Blueprint (Ministry of Education Malaysia, 2013). Within the STEM disciplines, chemistry functions as a central science, pivotal for fields ranging from medicine to materials engineering. However, its crucial role is often challenged by its reputation as a difficult subject, with certain topics posing significant difficulty to students, particularly those with lower math aptitude (Rosa & Lewis, 2018). This inherent challenge was significantly compounded by the recent global shift to remote learning during the COVID-19 pandemic, which altered the pedagogical landscape and introduced new obstacles to maintaining student engagement outside of the traditional classroom (Broad et al., 2023).

In response to these persistent challenges, a pedagogical shift is underway, moving from traditional teacher-centric instruction towards more dynamic, student-centered models. The focus of modern education is on fostering deep conceptual understanding and critical thinking, often through active learning methods (Freeman et al., 2014). However, the success of any approach hinges on student

motivation, which is intrinsically linked to the perceived relevance of the chemistry subject matter. Student engagement is particularly strong when chemistry is meaningfully linked to real-world issues, whether through semiconductor applications in general chemistry courses for engineering students or by explicitly framing chemistry learning outcomes in relation to sustainable development (Ramirez & Paderna, 2025). Students in the program explicitly emphasized that connecting classroom chemistry with concrete experiences is crucial, noting that integrating experiments, simulations, and case studies helps them move beyond rote learning and better understand how abstract concepts operate in real-world contexts (Acharya, 2024).

This international emphasis on student-centered learning is mirrored in Malaysia, where strengthening STEM education has become a national priority. Research within the local context confirms that while Malaysian students are positively inclined towards STEM, they also acknowledge its inherent difficulty (Nawawi et al., 2021). A crucial factor in overcoming this challenge appears to be practical engagement. Numerous local initiatives have demonstrated the power of hands-on learning, from modules that boost interest in rural schools (Nasrullah et al., 2021) to partnerships that connect students with scientists (Fadzil et al., 2019). This underscores a central theme: direct application is vital. Specifically in chemistry, a positive attitude among secondary students is strongly correlated with active participation in laboratory work facilitated by an engaging instructor (Wan Yunus & Mat Ali, 2018), a principle reinforced by the success of STEM-based service-learning programs (Abdul Rahim & Mustafar, 2024).

While existing research in Malaysia has shown that hands-on STEM activities can positively influence students' interest and perceptions, a deeper understanding of the learning journey of students within a full-time foundation program remains limited (Nawawi et al., 2021). To capture this evolution, this research was designed in two phases. The first phase, a preliminary study conducted at the start of the semester, established a baseline of the students' initial perspectives. This pre-semester investigation revealed a noticeable reliance on passive learning strategies alongside a strong preference for more active and supportive chemistry learning environments. It also indicated considerable anxiety related to chemistry learning, particularly in areas involving calculations, even among motivated students (Nawawi et al., 2021). This baseline provided a critical snapshot of students upon entry into the program, while leaving open the question of how these perceptions and learning strategies would evolve after a full semester of instruction

Building on the initial baseline findings, this paper presents the second phase of the study and provides a descriptive comparison of the pre- and post-semester survey data. The primary objective was to examine changes in students' perceptions and learning experiences throughout the chemistry course. Specifically, this study sought to answer the following questions: (1) How did students' attitudes and anxieties toward chemistry change over the semester? (2) In what ways did students' learning strategies and study approaches change throughout the course? and (3) How did students perceive the teaching and classroom environment during the learning process? The study aimed to provide additional insights into students' learning experiences in foundation-level chemistry and to offer practical considerations for improving teaching and learning practices in STEM education.

Methods

This section outlines the research methodology employed to examine students' learning experiences within a STEM foundation chemistry course. It covers the research design, research sample, instrument used for data collection, and procedures for data collection and analysis.

Research design

To effectively examine students' learning experiences throughout the semester, this study employed a pre–post mixed-methods survey design conducted over one academic semester. Data were collected at two distinct phases: an initial survey administered at the beginning of the semester to establish a pre-semester baseline, and a follow-up survey administered at the end of the course. This pre–post survey approach has commonly been used in STEM education research to examine changes in students' perceptions and learning experiences over time (Nawawi et al., 2021). Previous studies have also

highlighted the importance of examining students' emotional and learning experiences in science-related educational settings (Grabau et al., 2024).

The quantitative sections of both surveys were identical, allowing descriptive comparisons of student attitudes and learning strategies across the two phases. Consistency in the questionnaire items was maintained to support meaningful comparison between the pre- and post-semester responses. This design enabled the quantitative findings to reveal observable trends in students' perceptions, while the qualitative responses provided deeper insights into students' overall learning experiences throughout the course. Similar approaches combining quantitative and qualitative feedback have been used to better understand students' classroom experiences and perceptions in active learning environments (Rezai et al., 2025).

Research sample

The study involved a cohort of 80 foundation students enrolled in a STEM Foundation Programme at a public university in Malaysia, where chemistry was offered as a core subject. Participation in the study was voluntary and anonymous. The cohort consisted of students from mixed academic backgrounds, including students with and without prior chemistry studies at the SPM level. The same group of students participated in both the pre- and post-semester survey phases to provide comparative insights into students' learning experiences throughout the semester.

To minimise potential researcher bias, all survey responses were collected anonymously, and students were informed that their responses would be used solely for research purposes. Participation in the study did not affect students' course grades or academic standing. The analysis focused on aggregated responses rather than individual student identification.

Research instrument

The data collection instrument for this study was a researcher-developed five-section questionnaire. The instrument was informed by previous studies related to student anxiety and learning experiences in chemistry education (Chhetri et al., 2022). Previous research has also highlighted the importance of classroom environment and teaching approaches in influencing students' stress and anxiety levels in STEM education (Hsu & Goldsmith, 2021). In addition, active learning strategies have been associated with students' motivation, attitudes, and classroom engagement (Rezai et al., 2025). Research conducted in Asian educational contexts has further shown that assessment-related stress and science anxiety may influence students' learning experiences and academic performance (Grabau et al., 2024).

Sections A through D consisted of identical quantitative items administered in both the pre- and post-semester surveys to facilitate descriptive comparisons of students' perceptions over time. These sections employed a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) and focused on students' attitudes toward chemistry, learning difficulties, study strategies, and perceptions of teaching and learning experiences. The questionnaire included items related to confidence, nervousness, learning strategies, and classroom support, which are commonly explored in STEM and chemistry education research.

Section E consisted of open-ended qualitative questions. In the pre-semester survey, students were asked about their anticipated challenges and expectations regarding the chemistry course. In the post-semester survey, the open-ended questions focused on students' actual learning experiences, challenges encountered throughout the semester, and suggestions for improving the course.

Prior to administration, the questionnaire was reviewed by experienced lecturers involved in foundation-level STEM education to ensure the clarity, relevance, and appropriateness of the questionnaire items for the target respondents. Minor revisions were made to improve the wording and readability of several items based on the feedback received. Since the primary purpose of the study was to explore students' perceptions and learning experiences throughout the semester, no formal pilot testing or reliability analysis was conducted. This limitation has been acknowledged in the study.

Data collection and analysis

The pre-semester survey was administered at the end of the first week of lectures to establish a baseline of students' initial attitudes and perceptions. The post-semester survey was administered during the final week of the course. For the quantitative data, descriptive statistics, including the mean and standard deviation for each Likert scale item, were calculated using Microsoft Excel. Descriptive statistics were considered appropriate for the study as the primary objective was to examine overall patterns and observable changes in students' perceptions and learning experiences throughout the semester rather than to establish causal relationships (Rezai et al., 2025).

The quantitative findings from the pre- and post-semester surveys were descriptively compared to identify changes in students' attitudes, learning difficulties, study strategies, and perceptions of teaching and learning experiences over time. The qualitative responses from the open-ended questions in Section E were analysed descriptively by identifying recurring responses and common patterns related to students' learning experiences, challenges, and suggestions throughout the course. Representative responses were selected to illustrate the recurring themes identified from the students' feedback.

Result and Discussion

This section presents the findings related to students' learning experiences in a foundation chemistry course based on pre- and post-semester survey data. The findings are organised according to four chemistry-related dimensions: students' attitudes toward learning chemistry (Section A), chemistry-related learning difficulties such as calculations and conceptual understanding (Section B), chemistry learning strategies (Section C), and perceptions of chemistry teaching practices (Section D). Quantitative findings from both phases are presented side-by-side to facilitate descriptive comparisons of students' perceptions and learning experiences throughout the semester. These findings are further supported by qualitative feedback related to students' experiences with chemistry instruction and assessment. Table 1 shows the thematic structure of the questionnaire.

Table 1. Thematic structure of the questionnaire

Section	Theme	Number of items	
		Pre	Post
Profile	Demographic	4	4
A	Attitudes and Interest	10	10
B	Learning Difficulties	5	5
C	Learning Strategies	5	5
D	Teaching and Classroom Experience	-	5
E	Open-Ended Feedback on Chemistry Learning	-	5

Demographic profile

The study involved 80 students enrolled in a STEM Foundation Programme at a public Malaysian university. The majority of participants were 18 years old (85%), with a gender distribution of 62.5% female and 37.5% male. The ethnic composition consisted predominantly of Malay students (86.3%), with additional representation from Chinese, Indian, and Orang Asli students. In terms of academic background, 68.8% of students had prior chemistry education at the SPM level, while 31.2% entered the programme without formal chemistry instruction at the secondary school level. This variation in students' prior chemistry experience provided useful context for understanding differences in students' learning experiences throughout the course. The demographic characteristics of the participants are summarized in Table 2.

Table 2. Demographic profile of respondents (n=80)

Characteristic	Category	Frequency (n)	Percentage (%)
Age	17 years old	12	15.0
	18 years old	68	85.0
Gender	Male	30	37.5
	Female	50	62.5
Ethnic	Malay	69	86.2
	Chinese	7	8.8
	Indian	3	3.8
	Orang Asli	1	1.2
Prior Chemistry Experience	Yes	55	68.8
	No	25	31.2

Figure 1 illustrates the percentage of prior chemistry experience of the participants upon entering the foundation programme. While most students had prior chemistry education at the SPM level, a smaller group entered the programme without formal chemistry instruction.

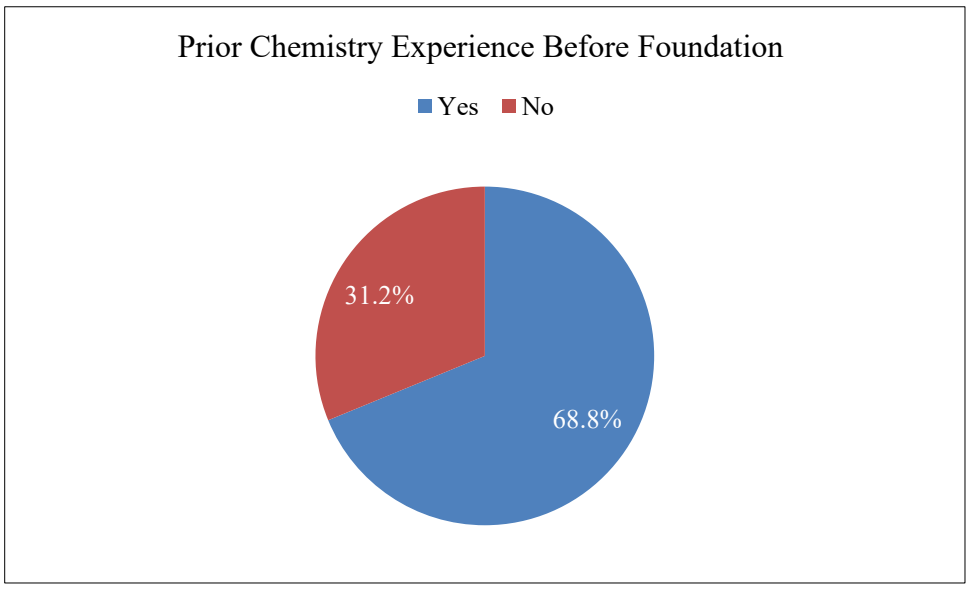


Figure 1. Percentage of prior chemistry experience of the participants

The variation in students' prior chemistry background provided important context for the teaching and learning process throughout the course. Students entered the programme with differing levels of prior chemistry knowledge and experience, which may have influenced their learning needs, confidence levels, and approaches to understanding chemistry concepts (Chhetri et al., 2022). This highlights the importance of providing clear instruction and adequate learning support to accommodate students with diverse academic backgrounds.

Section A: Students' attitudes toward learning chemistry

The primary objective of this study was to examine changes in students' attitudes toward chemistry over one semester. The comparative data presented in Table 3 indicate several observable changes in students' perceptions and attitudes toward the subject. Overall, the findings suggest generally positive trends in students' engagement and appreciation of chemistry throughout the semester. For example, students' perception of chemistry as a "fun" subject (Item 9) increased from a mean of 3.86 to 4.21, while the perception that chemistry helps develop critical thinking skills (Item 5) increased from 4.04 to 4.14.

These findings suggest that students increasingly recognised both the enjoyment and academic relevance of chemistry throughout the course.

Table 3. Comparative analysis of student attitudes and interest (pre- vs. post-semester) for Section A

Section A: Attitudes and Interest	Pre-Semester Mean	Post-Semester Mean	Change
1. I enjoy learning chemistry.	4.09	4.21	▲
2. I feel nervous when studying chemistry.	3.29	2.76	▼
3. I would like to take more chemistry-related courses.	3.39	3.41	▲
4. Chemistry is useful in my daily life.	3.65	3.71	▲
5. I think learning chemistry helps me think critically.	4.04	4.14	▲
6. I am interested in learning chemistry.	4.09	4.21	▲
7. I feel confident when learning chemistry.	3.69	3.26	▼
8. I believe chemistry is important for my future career.	4.14	4.02	▼
9. Chemistry is a fun subject to learn.	3.86	4.21	▲
10. I want to get good results in chemistry.	4.79	4.88	▲

Although the observed differences in mean scores between the pre- and post-semester surveys were relatively small, such changes may still provide useful insights within the context of attitudinal research, particularly when students begin the course with moderately positive baseline perceptions. In studies involving student attitudes and perceptions, incremental changes are commonly observed, as attitudes are often more stable and less likely to change rapidly over a short period. From this perspective, maintaining or slightly improving positive attitudes throughout a demanding chemistry course may be viewed as a favourable outcome.

In addition, students' reported nervousness when studying chemistry (Item 2) decreased from 3.29 to 2.76 over the semester, as shown in Figure 2. This finding may suggest that the learning environment contributed positively to students' comfort and engagement during the course. Previous studies have similarly reported that supportive instructional approaches may contribute to improvements in students' confidence, motivation, and willingness to engage with challenging subject matter (Hsu & Goldsmith, 2021).

Interestingly, while students' nervousness when studying chemistry decreased over the semester, self-reported confidence (Item 7) showed a slight decline from 3.69 to 3.26. This pattern may reflect students' increasing awareness of the cognitive and conceptual demands associated with chemistry as they progressed through the course. Previous research has suggested that deeper engagement with complex scientific content may influence how students evaluate their own understanding and abilities (Rezai et al., 2025).

At the same time, the reduction in nervousness suggests that students may have become more comfortable engaging with chemistry learning activities throughout the semester. The combination of reduced anxiety alongside more cautious self-assessment may indicate a more reflective approach toward learning chemistry, which has also been discussed in previous science education research (Grabau et al., 2024).

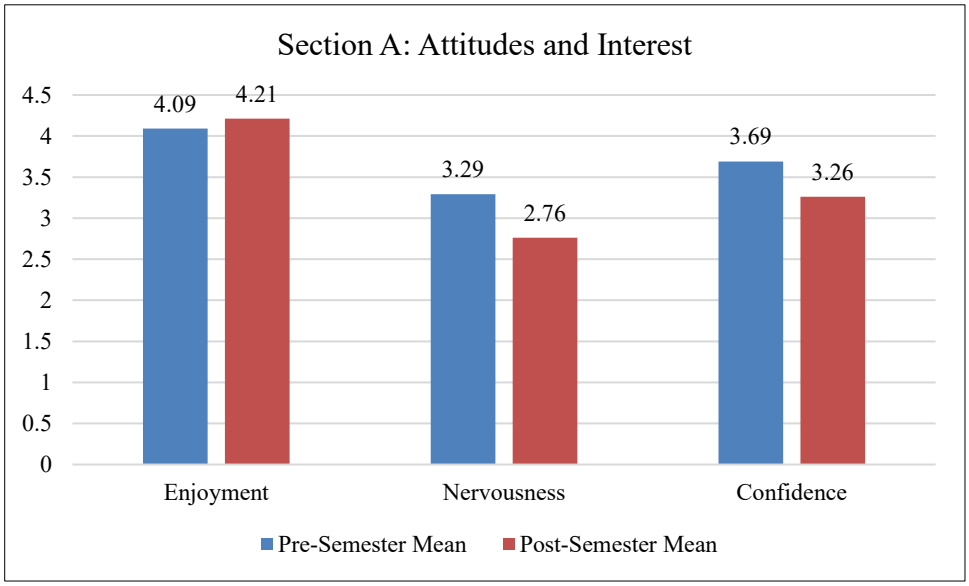


Figure 2. Changes in students' enjoyment, nervousness, and confidence levels before and after the semester

Section B: Chemistry-related learning difficulties

The pre-semester findings indicated that students experienced several learning difficulties related to chemistry, particularly in topics involving calculations and examinations. The post-semester findings presented in Table 4 suggest several observable changes in students' perceptions of these difficulties over the semester.

Among the items analysed, the mean score for calculation-related difficulty (Item 13) decreased from 4.08 to 3.24, indicating that students reported lower levels of difficulty with calculations by the end of the course. Similarly, anxiety before tests or examinations (Item 14) showed a slight decrease from 3.86 to 3.71. These changes are illustrated in Figure 3, which presents the comparison between pre- and post-semester mean scores for calculation challenges and test anxiety.

Table 4. Comparative analysis of learning difficulties (pre- vs. post-semester) for Section B

Section B: Learning Difficulties	Pre-Semester Mean	Post-Semester Mean	Change
11. I find it difficult to understand formulas.	2.71	2.80	▲
12. I struggle to remember concepts.	3.14	3.32	▲
13. I find calculations very challenging.	4.08	3.24	▼▼
14. I feel anxious before tests or exams.	3.86	3.71	▼
15. I get confused when learning new topics.	3.23	3.39	▲

The reduction in calculation-related difficulty and examination anxiety may suggest that students became more familiar with chemistry problem-solving processes throughout the semester. Previous studies have reported that anxiety related to complex scientific tasks and assessments may influence students' learning experiences in STEM-related subjects (Grabau et al., 2024).

However, not all learning difficulties demonstrated decreases in mean scores. Items related to understanding formulas (Item 11), remembering concepts (Item 12), and confusion when learning new topics (Item 15) showed slight increases in post-semester mean scores. This pattern may reflect students' increasing exposure to more complex chemistry content as the course progresses, leading to greater awareness of conceptual and cognitive challenges associated with the subject.

The qualitative feedback provided additional insights into how students managed these challenges throughout the semester. Several students highlighted the importance of practice, exercises, and reinforcement activities in supporting their understanding of chemistry concepts. One student stated, "I need to do more exercises to get used to the pattern of chemistry questions," while another identified tests and reinforcement exercises as particularly helpful.

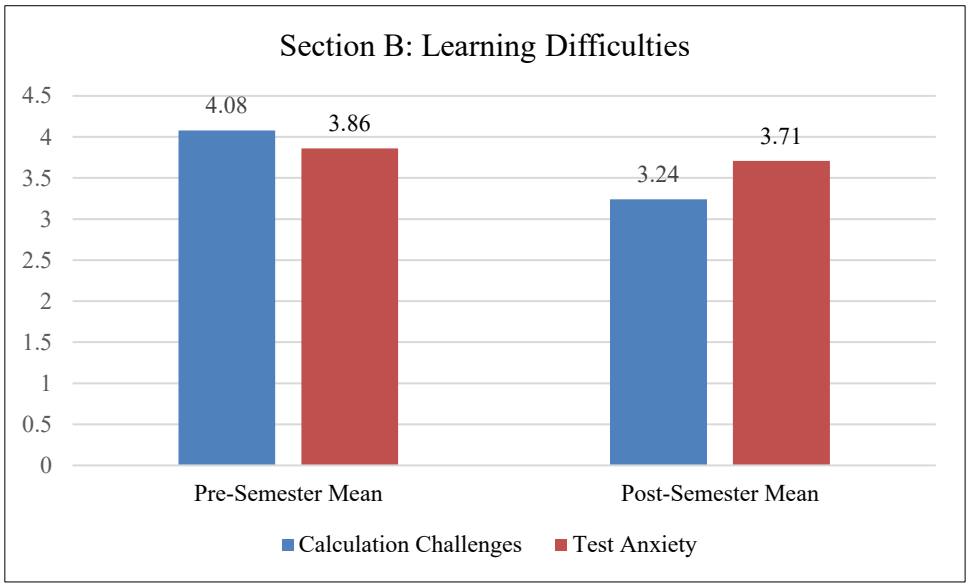


Figure 3. Changes in students' learning difficulties before and after the semester

Section C: Learning strategies

Table 5 presents the pre- and post-semester comparisons for students' reported learning strategies. Overall, most items demonstrated slight decreases in mean scores during the post-semester phase. These findings suggest that students' study approaches and learning preferences may have changed throughout the semester as they adapted to the demands of the chemistry course.

Table 5. Comparative analysis of learning strategies (pre- vs. post-semester) in Section C

Section C: Learning Strategies	Pre-Semester Mean	Post-Semester Mean	Change
16. I understand better through experiments.	4.31	3.73	▼
17. I use videos (e.g., YouTube) to learn.	3.99	3.76	▼
18. I prefer learning in groups with friends.	3.70	3.63	▼
19. I use memorization techniques.	4.29	3.90	▼
20. I revise chemistry topics regularly.	3.49	3.29	▼

Among the items analysed, the use of memorization techniques (Item 19) decreased from a mean score of 4.29 to 3.90. This change is illustrated in Figure 4. The reduction in reliance on memorization strategies may reflect changes in students' study preferences and approaches toward learning chemistry concepts throughout the semester.

Slight decreases were also observed in other learning strategy items, including learning through experiments, the use of videos for learning, group learning, and regular revision practices. These patterns may reflect changes in students' study habits, learning priorities, or adaptation to the pace and structure of the course throughout the semester. Given the descriptive nature of the findings, these changes should be interpreted cautiously.

Previous studies have reported that active learning strategies can positively contribute to students'

engagement and understanding of learning materials (Rahman et al., 2022). Similarly, active and interactive learning approaches have also been associated with improvements in students' motivation and classroom participation (Rezai et al., 2025).

The qualitative feedback from the present study also reflected students' interest in more active learning opportunities. When asked for suggestions to improve the course, one student suggested that students should be given more chemistry-related activities during the learning process. Together, these findings suggest that students became more reflective about the learning strategies and classroom experiences they found most useful throughout the course.

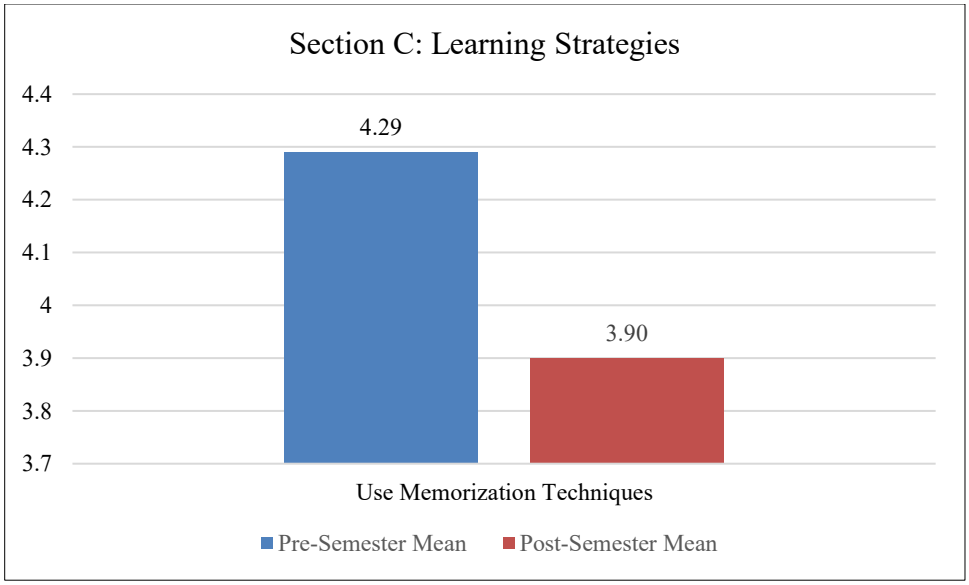


Figure 4. Changes in reported use of memorization learning strategy before and after the semester

Section D: Teaching and classroom experience

The final section of the quantitative analysis examined students' perceptions of the teaching and classroom experience throughout the course. The findings presented in Table 6 indicate generally positive perceptions across all items related to lecturer support, classroom activities, learning materials, and overall classroom experience.

Table 6. Post-semester perception of teaching and classroom experience in Section D

Section D: Teaching and Classroom Experience	Post-Semester Mean
21. My lecturer explains chemistry topics clearly.	4.41
22. Class activities help me understand chemistry better.	4.01
23. The notes and learning materials are easy to understand.	4.34
24. My lecturer gives time for questions and discussions.	4.38
25. I enjoy learning chemistry in this class.	4.34

Among the items analysed, students reported particularly positive perceptions regarding the lecturer's clarity in explaining chemistry topics (Item 21, M = 4.41). Students also responded positively toward the opportunity for questions and discussions during class sessions (Item 24, M = 4.38), as well as the notes and learning materials provided throughout the course (Item 23, M = 4.34). In addition, students generally agreed that they enjoyed learning chemistry in the classroom environment (Item 25, M = 4.34) and that classroom activities helped support their understanding of chemistry concepts (Item 22, M = 4.01).

Figure 5 presents students' ratings for selected aspects of the teaching and classroom experience, particularly lecturer clarity and overall enjoyment of the chemistry class.

Overall, the findings suggest that students perceived the teaching and classroom environment positively throughout the semester. Previous studies have reported that supportive instructional approaches may contribute positively to students' motivation, engagement, and learning experiences in STEM-related subjects (Hsu & Goldsmith, 2021). Similarly, interactive classroom approaches have also been associated with improvements in students' participation and learning experiences (Rezai et al., 2025).

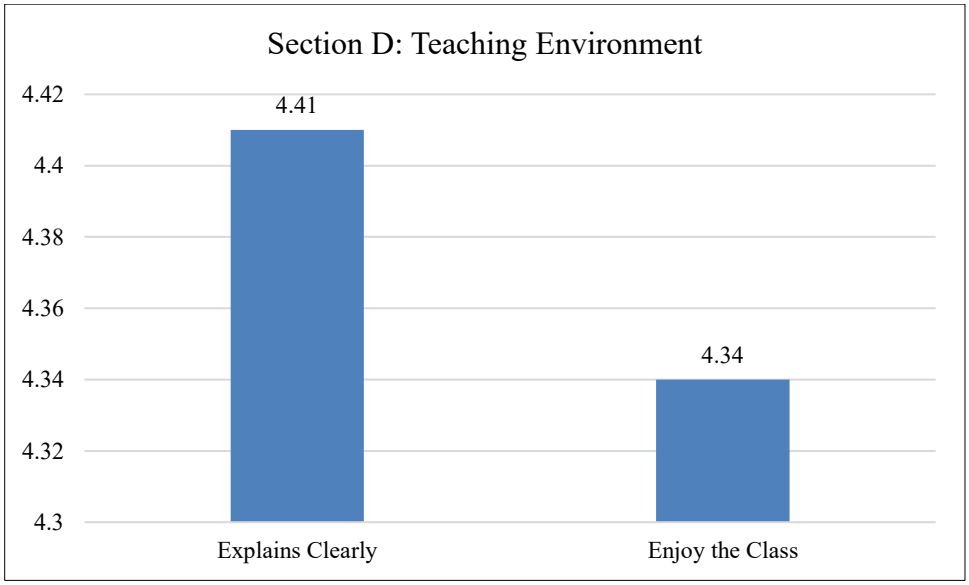


Figure 5. Student ratings of lecturer clarity and class enjoyment

Section E: Qualitative insights from students' feedback

The qualitative responses in Section E provided additional insights into students' learning experiences, learning preferences, and perceived challenges throughout the chemistry course. The responses were reviewed descriptively by identifying recurring responses and common patterns related to students' approaches to learning chemistry and the types of support they considered helpful.

One of the most frequently recurring patterns was the importance of practice and reinforcement activities in supporting students' understanding of chemistry concepts. Many students highlighted exercises, tutorials, revision activities, and repeated practice as useful learning strategies. Responses such as "do more exercises," "latih tubi," "more tutorials," and "a lot of practices" appeared consistently throughout the feedback. Several students also mentioned that answering questions repeatedly helped them become more familiar with chemistry question patterns and improve their confidence.

Another recurring pattern involved the importance of clear explanations, structured notes, and accessible learning materials. Students frequently referred to lecture notes, step-by-step explanations, and simplified teaching approaches as helpful in understanding difficult topics. Some students also expressed a preference for slower explanations, more examples, and the inclusion of visual aids such as videos, diagrams, and demonstrations to improve conceptual understanding.

In addition, students expressed interest in more active and collaborative learning opportunities throughout the course. Suggestions included group discussions, chemistry-related activities, quizzes, mentor–mentee approaches, and interactive classroom participation. Several students also described studying with friends, peer discussions, and collaborative learning as useful strategies for improving understanding and maintaining motivation during the course.

Visual and multimodal learning preferences were also commonly mentioned in the responses. Students referred to videos, experiments, drawing methods, flashcards, and visual learning approaches as helpful tools for remembering and understanding chemistry concepts. Some students additionally highlighted the value of using both English and Malay explanations when learning more complex chemistry topics.

Overall, the qualitative findings suggest that students valued clear explanations, repeated practice, active engagement, and supportive learning environments throughout the course. Previous studies have similarly reported that repeated practice and supportive instructional approaches may positively influence students' confidence and learning experiences in chemistry-related subjects (Chhetri et al., 2022). In addition, active learning opportunities have been associated with greater classroom engagement and participation among students (Rahman et al., 2022).

Conclusion

This study examined the learning experiences of foundation STEM students enrolled in a Malaysian chemistry course by exploring changes in students' perceptions across one academic semester using a pre–post survey design. The findings suggest several observable changes in students' attitudes, learning difficulties, learning strategies, and perceptions of the teaching and learning environment throughout the course. While students initially reported anxiety and concerns related to calculation-based topics and chemistry learning, the post-semester findings indicated lower reported nervousness and generally positive perceptions toward the classroom and learning environment. The findings also suggest that students' learning preferences and study approaches may have evolved throughout the semester. Although several academic challenges remained, the qualitative responses indicated that students valued clear explanations, repeated practice, supportive learning materials, and interactive learning opportunities as helpful elements in supporting their learning experiences.

Overall, the quantitative and qualitative findings suggest that supportive instructional approaches and structured learning environments may contribute positively to students' engagement and perceptions in foundation-level chemistry courses. Within the Malaysian foundation programme context, this study provides additional insight into students' learning experiences and highlights the potential importance of clear instruction, learning support, and active classroom engagement in chemistry education. This study also contributes to STEM education research by providing descriptive insights into students' perceptions and learning experiences throughout a foundation chemistry course. Future studies involving larger and more diverse student populations across multiple institutions are recommended to further explore students' learning experiences and the potential influence of different teaching approaches in chemistry education.

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Author Contribution

The sole author was responsible for all aspects of this research, including the conceptualization, study design, data collection and analysis, and the writing and editing of the manuscript.

Conflict of Interest

The author declares that there is no conflict of interest. The author's role as the course instructor is acknowledged as an inherent part of this pedagogical research, and steps were taken to ensure student anonymity and voluntary participation.

Declaration on the Use of Generative AI

During the preparation of this manuscript, the author utilized the generative AI tool Gemini (by Google). The tool's role was to assist in the following areas: structuring and drafting the manuscript, analysis and interpretation

of the quantitative and qualitative data, and enhancement of the text for clarity and academic tone. The author bears full responsibility for the final content, accuracy, and scientific integrity of this work.

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