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TEACHING IN A STEM FOUNDATION COURSENurul Nadia Zainal Abidin^{1*}¹ STEM Foundation Center, Universiti Malaysia Terengganu, MalaysiaEmail: nadia.zainal@umt.edu.my

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This work is licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)**Abstract:**

This study aimed to investigate the attitudes, challenges, and learning preferences of foundation-level STEM students in a Malaysian university chemistry course. A mixed-methods survey was conducted to identify key learning difficulties and perceptions of effective teaching strategies. The findings reveal a motivated but anxious student body, whose primary challenges involve the application of knowledge in calculations rather than understanding fundamental concepts. Although students rely on memorization, they express a strong desire for more active and visual learning methods, such as practice exercises and online videos. While satisfaction with the lecturer's clarity and support was very high, qualitative feedback highlighted a clear need for more practice opportunities and supportive resources. The study concludes that a significant disconnect exists between students' passive study habits and their desire for active, application-based learning, which likely fuels their anxiety. It is therefore recommended that educators foster a more active, visual, and supportive learning environment by integrating more problem-solving, utilizing multimedia, and providing differentiated support to better empower students and build their confidence.

Keywords:

Chemistry Education, Foundation Students, Student Attitudes, Learning Difficulties, Active Learning, Visual Learning.

Introduction

Science, Technology, Engineering, and Mathematics (STEM) education is widely regarded as a key driver of a nation's innovation and economic strength. Chemistry, in particular, is a foundational science that bridges disciplines from medicine to materials engineering. Despite

its importance, chemistry is frequently perceived by students as a formidable subject, largely because they struggle to connect the abstract molecular level with observable macroscopic phenomena (Sirhan, 2007). This long-standing challenge has been intensified by the recent global shift to remote learning, prompted by the COVID-19 pandemic. This transition was more than a logistical change; it fundamentally altered the educational experience and created new hurdles for keeping students engaged in a non-traditional classroom setting (Weldegiorges & Butler, 2023).

To address these learning challenges, educators worldwide are shifting from traditional, teacher-led instruction to more dynamic, student-centered approaches. Modern teaching philosophies now emphasize methods like research and project-based learning, which aim to build deeper conceptual knowledge and critical thinking skills (Pant & Baral, 2025). The effectiveness of these strategies, however, depends heavily on whether students feel motivated and see the subject as relevant. Research consistently shows that engagement improves when students can link chemistry to the real world. For instance, engineering students became more motivated when chemistry was taught in the context of semiconductor technology (Wu & Pimentel, 2024), and a clear connection has been found between academic success and understanding chemistry's role in sustainability (Villarante et al., 2025). A common thread throughout the literature is that students themselves are calling for more hands-on laboratory work, which they see as essential for understanding and applying complex theories (Pant & Baral, 2025).

Mirroring this international focus, Malaysia has made strengthening its STEM education a national priority. Within this local context, research shows that while students generally have a positive outlook on STEM, they openly acknowledge that it is difficult (Nawawi et al., 2021). What appears to make a significant difference is the opportunity for practical engagement. For instance, hands-on learning modules have proven effective at boosting interest and encouraging self-directed study, even in rural areas (Saidin et al., 2022). Likewise, partnerships that bring scientists into the educational process have enriched the student experience and opened their eyes to career possibilities (Abdullah et al., 2019). This highlights a core belief that hands-on application is key; indeed, secondary students develop a more positive attitude toward chemistry when they are actively involved in lab work with an engaging instructor (Jailani et al., 2018). This principle is further validated by initiatives that use service-learning to successfully foster greater student interest in STEM (Chai et al., 2024).

While a great deal of research has explored general STEM initiatives and student attitudes in Malaysia, there is still a noticeable gap in understanding the specific experiences of students in a foundation or pre-university program. This period is a critical turning point, as their experiences can heavily influence their confidence, drive, and eventual decision to continue with a STEM degree and career. For this reason, a dedicated study is necessary to explore the perspectives of these students, focusing on how they perceive chemical concepts and teaching methods within this crucial preparatory year.

This research, therefore, sets out to fill that gap by examining the perspectives of students within a Malaysian STEM foundation course. The study focuses on pinpointing the specific difficulties these students face, capturing their ideas on what makes teaching effective, and understanding how their classroom experiences influence their ongoing interest and self-belief in chemistry. The expected outcome is to provide valuable and practical insights for educators,

curriculum developers, and policymakers, which can be used to refine teaching methods, improve the student experience, and ultimately support the development of future STEM professionals in Malaysia.

Literature Review

Recent studies on STEM foundation courses are beginning to question the quality of the student experience, especially in chemistry. There is a growing unease about student engagement, the suitability of current teaching methods, and whether these programs are effectively preparing learners for advanced university study. While much of the existing research has focused on the broad challenges in STEM education, the perspective of the students themselves is often missing from this conversation, particularly during this critical preparatory stage.

To build a clear foundation for this research, this review will examine several key areas. It will begin by exploring the purpose of foundation programs and the common difficulties students encounter in chemistry. The review will then shift to innovative teaching strategies and the emotional and intellectual responses they elicit from students. By first considering these issues in a global context and then focusing on the specific situation in Malaysia, this review will identify the current gaps in understanding and establish the contribution of this study.

Challenges and Trends in Chemistry Education

The field of chemistry education is dynamic, shaped by both long-standing challenges and emerging pedagogical trends that influence how the subject is taught and learned on a global scale.

The Inherent Difficulties in Learning Chemistry

Chemistry has a persistent reputation as a difficult subject for several well-documented reasons. A primary challenge is its abstract nature. To achieve a true understanding, students must navigate three distinct but interconnected levels of representation: the macroscopic (observable phenomena), the sub-microscopic (the world of atoms and molecules), and the symbolic (formulas and equations) (Sevian & Talanquer, 2014). Managing these three levels simultaneously places a high cognitive load on learners, which can lead them to rely on simplistic rules and develop persistent misconceptions, such as those related to chemical stability (Taber, 2009).

Research indicates that math anxiety can substantially hinder a student's ability to solve chemistry problems. Rosa and Lewis (2018) observed that students with limited mathematical aptitude, which is often associated with elevated levels of math anxiety, encountered greater challenges when engaging with chemistry concepts that require quantitative reasoning. These existing difficulties were compounded by the recent COVID-19 pandemic, which forced a rapid transition to online learning models that often left students feeling isolated and disengaged from their instructors and peers (Weldegiorgis & Butler, 2023).

The Shift Toward Student-Centered Pedagogy

In response to these challenges, a significant pedagogical shift has occurred in STEM education. There is a growing movement away from traditional, teacher-centric lecture models and toward more active, student-centered approaches. A substantial body of research has demonstrated that students achieve better learning outcomes and higher performance when they are actively involved in the educational process (Freeman et al., 2014). This has led to the

widespread adoption of methods such as inquiry-based, problem-based, and project-based learning, which are designed to transform students from passive recipients of information into active constructors of their own knowledge (Pant & Baral, 2025).

The Critical Role of Motivation and Relevance

For any pedagogical approach to be successful, student motivation is essential. Foundational theories on motivation suggest that individuals are most engaged when they perceive a sense of autonomy and find personal value or interest in a task (Ryan & Deci, 2000; Glynn et al., 2011). In the context of chemistry, this underscores the importance of making the subject matter relevant to students' lives. Unsurprisingly, engagement and performance improve when students can connect chemical principles to tangible, real-world applications. For example, motivation among engineering students increased when chemistry was contextualized through semiconductor technology (Wu & Pimentel, 2024), and student performance has been strongly linked to an appreciation for chemistry's role in solving global challenges like sustainability (Villarante et al., 2025).

Student Perspectives on Effective Pedagogy

Beyond formal pedagogical theories, student feedback provides crucial insights into the classroom practices that most effectively support their learning.

The Importance of Practical, Inquiry-Based Laboratory Work

A consistent theme emerging from the literature is the student demand for hands-on, practical experience. From the students' perspective, the laboratory is where abstract theoretical concepts become concrete and understandable (Pant & Baral, 2025). However, they also make a clear distinction regarding the quality of this practical work. Students report gaining significantly more from laboratory sessions that encourage investigation and problem-solving, as opposed to exercises that merely require following a prescriptive, "cookbook-style" set of instructions. The most impactful learning occurs when students are engaged in the authentic scientific process, from formulating a question and designing an experiment to interpreting the final results (Galloway & Bretz, 2015).

The Role of the Instructor and Classroom Climate

The curriculum is only one part of the educational equation; the instructor and the overall classroom environment have a profound impact on student success. Learning is fundamentally a social process, not an isolated one (Stowe & Cooper, 2017). Instructors who demonstrate passion, approachability, and create a supportive atmosphere can significantly influence a student's attitude toward a subject. When students feel that their classroom is a safe space to ask questions, make mistakes, and collaborate with peers, their learning-related anxiety decreases. This fosters a stronger sense of belonging, which is a critical factor in student retention and persistence, particularly in a challenging field like chemistry.

The Malaysian Context: National Goals and Student Realities

To situate this study within a local context, this section explores how these global educational trends are reflected in Malaysia, examining the intersection of national STEM policy and the realities of the student experience.

National STEM Initiatives and Student Attitudes

In alignment with global priorities, Malaysia has identified the strengthening of STEM education as a critical component of its national development strategy, as outlined in frameworks like the Malaysia Education Blueprint (Ministry of Education Malaysia, 2013). Research conducted within Malaysia indicates that pre-university students generally possess a positive outlook toward STEM fields and recognize their importance. However, this optimism is tempered by a candid acknowledgement that they perceive these subjects to be exceptionally challenging (Nawawi et al., 2021).

Effective Educational Practices in the Malaysian Context

Local research confirms that pedagogical strategies proven effective internationally also yield positive results in Malaysia. Hands-on, practical projects have been particularly successful in fostering student interest and promoting self-directed learning, with notable success even in rural schools (Saidin et al., 2022). Furthermore, collaborative models that connect students with practicing scientists and teachers have been shown to enrich the learning experience and broaden student awareness of potential STEM careers (Abdullah et al., 2019). The principle that practical application is paramount is echoed by Malaysian secondary students, who report a more positive attitude toward chemistry when they actively participate in laboratory experiments under the guidance of an engaging instructor (Jailani et al., 2018). The success of service-learning programs in cultivating greater student interest in STEM further substantiates this finding (Chai et al., 2024).

Identifying the Research Gap and the Present Study

Synthesizing the literature from both global and Malaysian contexts reveals a clear consensus: effective chemistry education is student-centered, relevant, and emphasizes hands-on application. While these principles are well-established for secondary school and undergraduate levels, a significant gap in the research remains. There has been a notable lack of focus on the unique experiences of students during the critical transitional period of their foundation or pre-university year in Malaysia.

This stage is a pivotal juncture where students solidify their academic interests and make crucial decisions about their future careers. Therefore, this study aims to address this gap by focusing on the perspectives of these students as they prepare for higher education in STEM. By listening to their voices, this research seeks to gain a deeper understanding of their experiences in learning and being taught chemistry in this formative environment.

Methodology

This chapter describes the research methodology used to explore student perspectives on chemistry education within a STEM foundation program. It covers the overall research design, the cohort of participants, the instrument used for data collection, the methods for data analysis, and the ethical principles that guided the study.

Respondents and Demographic Profile

This study involved 80 foundation students enrolled in a STEM Foundation Programme at a local Malaysian university, all of whom were taking chemistry as a core subject. Participation was voluntary, and responses were collected anonymously through an online questionnaire administered during the semester.

The demographic profile of the respondents was collected, covering characteristics such as age, gender, ethnicity, and prior educational background in chemistry. This information was used to describe the sample cohort and provide context for the study's findings.

A key characteristic of the cohort was its mixed academic background, as it included students both with and without prior chemistry studies at the SPM level. This diversity is valuable as it provides a more comprehensive understanding of the distinct challenges and learning experiences faced by students from both science and non-science streams as they navigate chemistry at the foundation level.

Research Design

This study utilized a descriptive, cross-sectional survey design to effectively gather a wide range of information from the student population at a single point in time. The research employed a mixed-methods approach, which integrated quantitative data from scaled-response questions with qualitative data from open-ended questions. This combination allows for a comprehensive analysis, where quantitative results can provide a broad overview of trends, while qualitative findings offer deeper, more nuanced insights into the students' personal experiences. The research was guided by a pragmatic paradigm, focusing on using the most effective methods to best address the research questions.

Data Collection and Analysis

The questionnaire for this study was developed by the researcher and consisted of several sections designed to capture a range of student information. The initial section gathered demographic data, including students' age, gender, race, and prior exposure to chemistry at the secondary school level (SPM). Following this, Sections A through D contained closed-ended items using a 5-point Likert scale (from 1 = "Strongly Disagree" to 5 = "Strongly Agree") to assess students' attitudes, learning difficulties, study strategies, and classroom experiences. The survey items were adapted from previous educational studies and revised to suit the specific context of a foundation chemistry course. The final part, Section E, included open-ended questions for qualitative feedback.

The quantitative data collected from Sections A to D were analyzed using descriptive statistics in Microsoft Excel. Mean scores were calculated for each item, and the findings were summarized in tables and bar charts. This analysis provided an overview of trends in student perceptions regarding various aspects of learning chemistry.

For the qualitative portion of the study, the written responses from the three open-ended questions in Section E were analyzed using thematic coding. This process involved identifying recurring ideas and keywords, which were then grouped into common themes such as "practice and exercises," "better explanation," "visual learning," and "lecturer support." A thematic frequency analysis was conducted to identify the most prominent themes, and a word cloud was generated to visually represent the findings. By combining quantitative and qualitative analysis, the study was able to achieve a more comprehensive understanding of the students' experiences, challenges, and preferences in learning chemistry at the foundation level.

Results and Discussion

The key attitudinal, experiential, and instructional themes observed in this study were measured using a structured questionnaire distributed to students enrolled in a STEM foundation

chemistry course. A total of 80 student responses were collected and analyzed quantitatively through average Likert scale scores for each item across five main sections. These sections cover students' attitudes and interests toward chemistry, perceived learning difficulties, learning strategies adopted, and perceptions of teaching quality, along with open-ended qualitative responses.

The survey responses are organized into five thematic sections that reflect students' experiences and perspectives related to learning chemistry in a STEM foundation course. These include their overall attitudes toward chemistry (Section A), learning difficulties encountered (Section B), strategies used when studying (Section C), perceptions of teaching (Section D), and open-ended reflections on their learning process (Section E). Each section is discussed below in detail, highlighting key trends, high- and low-rated items, and qualitative insights that contribute to a deeper understanding of the students' academic and emotional engagement with chemistry. Together, the findings present a nuanced view of student motivation, instructional effectiveness, and areas requiring pedagogical attention.

Table 1: Thematic Structure of the Questionnaire

Section	Theme	Number of items
Profile	Demographic	4
A	Attitudes and Interest	10
B	Learning Difficulties	5
C	Learning Strategies	5
C	Teaching and Classroom Experience	5
E	Open-Ended Feedback on Chemistry Learning	3

Demographic Profile

The participant cohort consisted of 80 students enrolled in a STEM Foundation Programme at a public university in Malaysia. The demographic profile is characteristic of a typical pre-university intake. The majority of respondents (85%) were 18 years of age. In terms of gender distribution, female students represented a larger portion of the sample (62.5%) than male students (37.5%). The ethnic composition was predominantly Malay (86.3%), with representation from Chinese, Indian, and Orang Asli students, reflecting the nation's diverse population.

A critical demographic factor to emerge from the data was the varied academic preparation of the students. While most participants (68.8%) had previously studied chemistry at the secondary level (SPM), a significant minority of 31.2% entered the program without any prior formal instruction in the subject. This finding underscores a key challenge for the program: the need to accommodate a diverse cohort with mixed levels of foundational chemistry knowledge.

For a clear overview, here is the data presented in a summary table:

Table 2: Demographic Profile of Respondents (n=80)

Characteristic	Category	Frequency (n)	Percentage (%)
Age	17 years old	12	15
	18 years old	68	85
Gender	Male	30	37.5

	Female	50	62.5
Race	Malay	69	86.3
	Chinese	7	8.8
	Indian	3	3.8
	Orang Asli	1	1.3
Prior Chemistry Experience	Yes	55	68.8
	No	25	31.2

Section A: Attitudes and Interest in Chemistry

Section A examined students' general attitudes and emotional engagement toward chemistry as a subject. The results revealed an overall positive disposition among respondents, with high levels of academic motivation, interest, and enjoyment. Table 3 presents the average scores for each statement.

Table 3: Analysis of Attitudes & Interest in Chemistry (n=80)

Statement	Mean Score	SD
I want to get good results in chemistry.	4.56	0.59
I enjoy learning chemistry.	4.2	0.84
I am interested in learning chemistry.	4.2	0.84
Chemistry is a fun subject to learn.	4.13	0.77
Chemistry helps me think critically.	4.1	0.94
Chemistry is useful in my daily life.	3.9	0.88
Chemistry is important for my future career.	3.83	0.92
I feel confident when learning chemistry.	3.69	1.05
I would like to take more chemistry-related courses.	3.49	0.9
I feel nervous when studying chemistry.	2.85	1.21

The survey results paint a picture of students who are genuinely motivated but also quite anxious. On one hand, the desire to succeed is the most dominant attitude, with students strongly agreeing that they want to get good results ($M = 4.56$). This ambition is backed by a real interest in the subject, as they report enjoying chemistry and finding it interesting ($M = 4.20$ for both). They also see its value, believing it is important for their future careers ($M = 4.10$) and helps them think critically ($M = 4.13$).

On the other hand, this positive outlook is undercut by a clear lack of confidence. The statement "I feel confident when learning chemistry" scored quite low ($M = 3.49$), revealing widespread self-doubt. This is reinforced by the varied but present feelings of nervousness ($SD = 1.21$), suggesting that anxiety is a significant factor for many. This key contrast between high motivation and low confidence suggests that while these students are engaged, they are also grappling with intimidation, a factor that likely impacts how they approach the subject.

This combination of high motivation but moderate confidence is consistent with findings in STEM education literature, where students may value a subject yet feel intimidated by its complexity. To support these learners, instructional strategies such as peer collaboration, scaffolded exercises, and low-stakes assessments could help reinforce confidence and reduce cognitive overload.

Section B: Learning Difficulties

This section of the survey aimed to identify the primary challenges students face when learning chemistry. The results, detailed in Table 4, clearly indicate that emotional and psychological pressures, such as test anxiety, are perceived as the most significant hurdles. This is followed by difficulties with the mathematical aspects of chemistry and the memorization of concepts.

Table 4: Analysis of Learning Difficulties in Chemistry (n=80)

Statement	Mean	SD
I feel anxious before chemistry tests or exams.	3.86	1.14
I find topics involving calculations challenging.	3.43	1.18
I struggle to remember chemistry concepts.	3.33	1.16
I get confused when learning new chemistry topics.	3.29	1.08
I find it difficult to understand chemical formulas.	2.74	1.13

The findings from this section pinpoint test related anxiety as the most significant learning difficulty students face, with a mean score of 3.86. This emotional challenge appears to be more pronounced than the cognitive difficulties themselves, reinforcing the theme of low confidence identified in the previous section. Following anxiety, the most prominent academic challenge is with topics involving calculations, such as stoichiometry ($M = 3.43$). This suggests that students' difficulties are less about understanding the conceptual language of chemistry, since understanding formulas was rated as the least difficult aspect ($M = 2.74$), and more about the mathematical application of those concepts under pressure.

The struggle to remember chemistry concepts ($M = 3.33$) further highlights a reliance on memorization that may not be effective for long term retention, a point that will be explored in the analysis of learning strategies. These results indicate that effective pedagogical support must address not only the technical aspects of the subject but also the significant psychological and emotional pressures that students experience.

In summary, the findings indicate that students' learning difficulties in chemistry are primarily linked to symbolic interpretation, complex calculations, information retention, and emotional anxiety. These results suggest that teachers should adopt more visual-based, scaffolded, and emotionally supportive teaching approaches to help students navigate foundational chemistry topics more effectively.

Section C: Learning Strategies in Chemistry

Section C investigated the range of learning strategies employed by students in the chemistry classroom. The statements assessed students' use of digital tools, memorization techniques, group learning, revision habits, and hands-on methods. The results, presented in Table 5, indicate that students rely on a mixture of visual, tactile, and collaborative strategies to support their learning.

Table 5: Analysis of Learning Strategies in Chemistry (n=80)

Statement	Mean	SD
I use memorization techniques to study chemistry.	4	0.86
I use videos (e.g., YouTube) to help me learn.	3.81	1.01
I understand better through hands-on experiments.	3.7	1.1
I prefer learning chemistry in groups with friends.	3.6	1.25
I revise chemistry topics regularly every week.	3.46	1.04

The analysis of learning strategies reveals that students primarily rely on traditional memorization techniques (Mean = 4.00) to cope with the subject's content. This finding is consistent with the previously identified struggle to remember concepts and suggests that students may be adopting surface-level learning approaches rather than seeking deeper conceptual understanding. This traditional method is increasingly supplemented by modern resources, with a strong preference for using online videos to aid learning (Mean = 3.81), indicating a shift towards visual and self-paced digital media.

Interestingly, while there is a strong consensus that hands-on experiments are beneficial for understanding (M = 3.70), the lack of consistent, regular weekly revision (M = 3.46) suggests that study habits may be more reactive, likely intensifying only before assessments.

The wide variation in opinions regarding group study (SD = 1.25) indicates that collaborative learning is not a universally adopted strategy, with many students still preferring to learn individually. Overall, these findings portray a student body that values practical and visual learning but defaults to memorization, potentially due to a lack of consistent study habits or alternative strategies. The emphasis on hands-on experiments implies that incorporating lab activities, demonstrations, or simulations into teaching can significantly enhance student engagement and comprehension.

Section D: Teaching and Classroom Experience in Chemistry

Section D examined students' perceptions of the quality of teaching and their classroom experiences in the STEM Foundation chemistry course. Five items were evaluated, focusing on clarity of instruction, the usefulness of classroom activities, learning materials, opportunities for discussion, and overall enjoyment of learning. The results, presented in Table 6, are overwhelmingly positive, indicating a very high level of student satisfaction with their lecturer and the course's structure.

Table 6: Analysis of Teaching and Classroom Experience (n=80)

Statement	Mean	SD
My lecturer explains chemistry topics clearly.	4.36	0.77
My lecturer gives time for questions and discussions.	4.36	0.75
The notes and learning materials are easy to understand.	4.21	0.88
I enjoy learning chemistry in this class.	4.1	0.84
Class activities help me understand chemistry better.	3.91	0.9

The findings regarding students' perceptions of the teaching environment are exceptionally positive, highlighting the crucial role of the instructor in shaping the learning experience. Students expressed a very high degree of satisfaction with their lecturer, giving the highest

ratings to the clarity of explanations ($M = 4.36$) and the provision of time for questions and discussions ($M = 4.36$). The strong consensus on these points ($SD < 0.8$) underscores the lecturer's effectiveness in delivering content and fostering an interactive environment. This positive perception extends to the learning materials and notes, which students found easy to understand ($M = 4.21$).

While the overall classroom experience was rated favorably, with students reporting they enjoy learning in this class ($M = 4.10$), the data suggests a potential area for enhancement. In-class activities, while still viewed as helpful, received the lowest mean score in this section ($M = 3.91$). This subtle difference indicates that while students highly value the lecturer's direct instruction and the provided resources, the activities designed to supplement this teaching may not be as universally effective or engaging.

Overall, the data suggest that students perceive their chemistry learning environment as supportive, clear, and engaging. The consistently high ratings across all five items reflect a well-structured teaching approach that balances explanation, interaction, and enjoyment. This also aligns with qualitative feedback where students requested more hands-on practice, suggesting a desire for activities that are more directly linked to application and problem-solving.

Section E: Open-Ended Feedback on Chemistry Learning

To capture the students' perspectives in their own words, the survey included three open-ended questions. A thematic analysis of these responses was performed, which yielded three recurring themes that powerfully explain the quantitative results. These themes were: the critical need for applied practice, a strong preference for visual and simplified instruction, and the value of a robust support system.

Theme 1: The Demand for Practice and Application

By a significant margin, the most prevalent theme was an overwhelming demand for more opportunities to practice. The most frequent requests were for more "practice," "exercises," and "past year questions." This feedback directly corresponds to the difficulties with calculations (Section B) and the over-reliance on memorization (Section C) reported earlier. Students articulated a clear belief that applying chemical concepts through active problem-solving is the most effective path to genuine understanding. As one respondent noted, "a lot of hands-on exercises" are needed to bridge the gap between theory and application. This suggests that while students value clear instruction, they consider their learning incomplete without the chance to actively apply the knowledge themselves.

Theme 2: The Preference for Visual and Simplified Learning

The second major theme was a call for more visual learning aids. Students repeatedly stated that their comprehension is enhanced when instructors use tools like "videos," "animations," and "diagrams." This finding aligns with the reported popularity of YouTube as a study resource (Section C). Additionally, a notable number of students, especially those new to the subject, asked for a slower pace and "simpler language." One student's request for a "step by step and slow lecture because I never studied chemistry in high school" poignantly illustrates the challenge of teaching a mixed-ability cohort and the need for methods that make abstract ideas more accessible.

Theme 3: The Importance of Lecturer and Peer Support

The final theme centered on the necessity of a strong support network. Students expressed high value for resources like "clear, concise notes" and a desire for more "consultation time with lecturers." The importance of peer support was also a recurring point, with students finding it helpful to "study in a group with friends." This theme underscores that learning is a socially mediated process. It also reflects the high ratings given to the lecturer (Section D), who is viewed not just as an information source but as a vital part of the students' support system.

In summary, the qualitative data provides a clear path forward. Students are motivated and appreciate their instructors, but they are asking for a learning environment that is more active, visual, and supportive. Fulfilling these needs would likely help them overcome their anxiety and build the confidence necessary for success.

Table 7: Most Frequently Mentioned Keywords in Student Feedback by Theme

Theme 1: Practice & Application	Theme 2: Visual & Simplified Learning	Theme 3: Support & Resources
Practice	Video	Notes
Questions	Visual	Friends
Exercises	Step-by-step	Consultation Time
Past Year Exam	Simple explanation	Simplified Formula
Repeating xplanation	Bahasa Melayu	Help
Hands-on activity	Pictures	Recorded Lecture
	Examples	

The keywords presented in Table 7 strongly illustrate the students' primary demand for active learning, as seen in the frequent mention of terms like 'practice,' 'questions,' and 'exercise.' The data similarly points to a strong preference for more accessible instruction, highlighted by words such as 'video,' 'visual,' and 'slow.' Furthermore, the importance of a comprehensive support network is underscored by the recurrence of keywords like 'notes,' 'friends,' and 'consultation.'

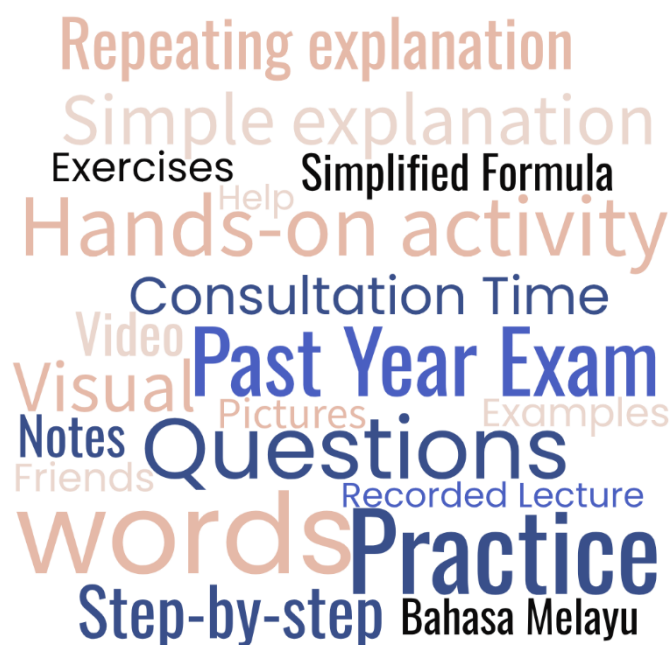


Figure 1: Word cloud result of sub-thematic analysis

Source: <https://www.wordclouds.com/>

Conclusion

This study's exploration of the foundation-level chemistry experience reveals a clear and consistent narrative. The findings portray a student cohort that is highly motivated and genuinely interested in the subject, yet is simultaneously hindered by significant anxiety and a lack of confidence. Their primary difficulties are not in understanding the fundamental language of chemistry, but in applying concepts, particularly through mathematical calculations, and in retaining the subject's vast amount of information. To manage this, students tend to rely on passive memorization, though they supplement this with modern digital resources like online videos.

The central insight of this research is the pronounced misalignment between how students currently approach their studies and how they desire to learn. While their default strategy is passive, their feedback expresses a strong craving for active learning, including problem-solving, hands-on exercises, and visual explanations. This disparity is a likely source of their anxiety, as they may sense a more effective path to learning but lack the opportunities or strategies to pursue it. While students reported high satisfaction with their lecturer's supportive style, their qualitative comments highlighted unmet needs, such as more time for discussion and structured tools for consistent practice.

Therefore, the path forward requires bridging this gap between passive and active learning. The recommendations are to integrate more hands-on problem-solving into class, enhance lessons with multimedia resources, and offer differentiated support for students with varied academic backgrounds. By fostering an environment that is more active, visual, and supportive, educators can build on existing student motivation, reduce anxiety, and empower them to achieve a lasting and deep understanding of chemistry.

Although this study offers valuable insights, its findings are specific to one institution and may not be broadly generalizable. Future research could expand on this work through longitudinal studies, by evaluating the implementation of these recommendations, or by comparing data across different institutions. Ultimately, attending to the student voice provides an actionable framework for moving beyond rote memorization to cultivate a more resilient and meaningful understanding of chemistry.

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