

Early Diagnostic Analysis of Chemistry Students' Learning Profiles: Motivation, Study Habits, and Affective Factors

Sumiati Side¹, Ayu Ashari², Munawwarah^{3*}

^{1,2,3*}Chemistry Education Study Program, Faculty of Mathematic and Natural Science, Universitas Negeri Makassar, Indonesia

Article Info

Article history:

Received Feb 30, 2026

Accepted Apr 13, 2026

Published Online May 25, 2026

Keywords:

Early diagnostic assessment

learning profiles

chemistry education

study habits

affective factors

ABSTRACT

This study reports an early diagnostic analysis of chemistry students' learning profiles at the beginning of a course ($n = 53$). Using a mixed-methods descriptive survey, motivation and learning goals, study habits, affective factors, learning conditions, and brief reflections were collected and analyzed descriptively and thematically. Students showed high motivation and mastery-oriented goals ($M = 4.40$, $SD = 0.35$), but study habits were only moderate ($M = 3.80$, $SD = 0.53$), with regular studying showing the lowest tendency ($M = 3.34$). Affective results indicated moderate chemistry confidence ($M = 3.83$) but lower mathematics confidence ($M = 3.32$), alongside substantial test anxiety ($M = 3.72$; 58.49% agree). Contextually, most students reported ≤ 4 hours of weekly independent study time and varying learning environments 54.72% relied on smartphones with intermittently unstable internet. Qualitative themes emphasized conceptual difficulty, pacing, and quantitative demands, supporting the need for scaffolded instruction and flexible learning supports.

This is an open access under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) licence



Corresponding Author:

Munawwarah,

Chemistry Education Study Program,

Faculty of Mathematic and Natural Science

Universitas Negeri Makassar, Makassar, Indonesia,

Jl. Daeng Tata, Parang Tambung, Kec. Tamalate, Kota Makassar, Sulawesi Selatan 90224

Email: munawwarah@unm.ac.id

How to cite: Side, S., Ashari, A., & Munawwarah, M. (2026). Early Diagnostic Analysis of Chemistry Students' Learning Profiles: Motivation, Study Habits, and Affective Factors. *Jurnal Riset Dan Inovasi Pembelajaran*, 6(2), 532–544. <https://doi.org/10.51574/jrip.v6i2.5009>

Early Diagnostic Analysis of Chemistry Students' Learning Profiles: Motivation, Study Habits, and Affective Factors

1. Introduction

Chemistry learning at the university level requires students to integrate conceptual understanding with procedural skills such as abstract reasoning, problem-solving, and mathematical representations. For pre-service chemistry teachers, the challenge is intensified because they must also connect concepts to everyday phenomena and school contexts. In practice, instructional expectations often diverge from students' learning realities, which may include irregular study habits, limited independent study time, uncondusive learning environments, and assessment anxiety that interferes with clear thinking. This discrepancy is shaped by multiple factors, including the pedagogical content knowledge (PCK) of pre-service teachers, which is often insufficient to support chemistry learning (Deng et al., 2024; Mönch & Markic, 2024). Moreover, psychological barriers can limit students' ability to apply conceptual knowledge; science students, including pre-service chemistry teachers, frequently report elevated anxiety that impedes learning (Suhaimi et al., 2024) ridge expectations and experiences (der Merwe, 2022). Addressing psychosocial factors can create learning environments that foster conceptual and procedural competence (Can-Kucuk et al., 2022).

Research in science education consistently indicates that learning success is not determined solely by cognitive ability but is also shaped by non-cognitive factors such as motivation, learning goals, study habits, self-confidence (self-efficacy), academic anxiety, and learning conditions. These factors influence students' engagement, persistence when facing difficulties, and their capacity to regulate learning strategies effectively. Consequently, understanding students' learning profiles at the beginning of a course is essential for instructors to design instruction, learning support, and assessment strategies that are responsive to students' actual needs rather than relying on uniform instructional approaches. Research has shown that self-efficacy plays a crucial role in enhancing student engagement and can mitigate anxiety during challenging academic situations, particularly in science education (Yang et al., 2020). Furthermore, motivation and learning goals significantly drive students' efforts and persistence, which impacts their overall success in courses. It is also vital for educators to consider the diversity of learning conditions that affect student access and engagement, thereby warranting a tailored approach to teaching and learning (Gelabert et al., 2020). Additionally, studies underscore the importance of profiling students to better understand their unique learning needs and designing adaptive instructional methods, which can ultimately improve their academic experiences and outcomes (Sibanda et al., 2021). By recognizing these non-cognitive factors, educators can create a more inclusive and effective learning environment that supports all students in achieving their educational goals.

Despite growing recognition of diagnostic assessments, gaps remain in early-course profiling research in chemistry education. Many studies examine isolated dimensions such as motivation or study habits without addressing how cognitive, affective, and contextual factors interact to shape learning. In addition, diagnostic survey findings are often presented descriptively without being translated into actionable instructional implications. Evidence shows that pre-service teachers' pedagogical content knowledge (PCK) substantially influences teaching effectiveness, yet research frequently underestimates the complexity of integrating cognitive and emotional factors in assessment and instruction (Purba et al., 2023). Qualitative insights into students' learning processes can add essential context that quantitative data may miss, but this perspective remains underexplored (Mönch & Markic, 2024). Moreover, focusing on discrete factors such as motivation without examining their interaction with broader educational contexts may overlook critical determinants of learning outcomes. Therefore, a more integrated approach to profiling chemistry learners could strengthen teacher education by

aligning instructional strategies with the lived needs and experiences of pre-service educators (Li et al., 2022).

To address these gaps, this study presents a comprehensive early diagnostic analysis of chemistry students' learning profiles with a clear orientation toward instructional improvement. The analysis integrates motivation and learning goals, study habits, affective factors (self-confidence and anxiety), and learning conditions and access within a single framework administered at the beginning of the course. Quantitative findings from scaled responses are triangulated with students' brief reflective responses on learning difficulties, effective strategies, and instructional expectations, enabling a richer and more contextualized interpretation that directly supports pedagogical decision-making. Prior research emphasizes that multifaceted approaches are necessary because isolated analyses often fail to capture interactions among cognitive and emotional factors that shape learning outcomes (Darmastuti et al., 2025). Inquiry-based approaches, for instance, can enhance engagement by aligning learning goals with effective study practices (Martini Meilani & Faradiba, 2019). In addition, qualitative insights from reflective assessments can deepen interpretations of quantitative measures by clarifying students' perceived challenges and expectations (Irwanto et al., 2022). This integrated methodology aligns with calls for responsive, holistic pedagogical frameworks in STEM education.

Accordingly, the purpose of this study is threefold. First, to describe chemistry students' initial learning profiles at the beginning of university courses in terms of motivation and learning goals, study habits, self-confidence and anxiety, and learning conditions and access. Second, to identify dominant learning challenges and preferred learning strategies based on students' reflective responses. Third, to formulate instructional implications that can support the design of more adaptive, structured, and supportive chemistry learning experiences. Through these objectives, the study seeks to contribute empirical evidence that can guide instructors in fostering meaningful learning, strengthening conceptual understanding, and supporting the development of competent pre-service chemistry teachers.

2. Method

Research Design

This study employed a descriptive survey using a mixed-methods diagnostic approach to examine students' initial learning profiles at the beginning of a university chemistry course. Quantitative data were used to describe tendencies across key learning dimensions, while qualitative data from brief reflective responses were used to enrich and explain the quantitative findings.

Participants and Context

The participants were 53 undergraduate chemistry students Universitas Negeri Makassar, primarily pre-service chemistry teachers, enrolled in a chemistry course at the beginning of the semester. Participants were selected through convenience sampling based on course enrollment. The study focused on students' baseline learning characteristics prior to the implementation of major instructional interventions.

Instrument

Data were collected using an Early Course Diagnostic Questionnaire developed to capture multiple dimensions of students' learning profiles. The questionnaire consisted of two parts. The first part comprised 16 Likert-scale items measured on a 5-point scale (1 = strongly disagree to 5 = strongly agree), organized into three constructs: motivation and learning goals, study habits, and affective factors, including self-confidence and academic anxiety. One item reflecting a performance-oriented goal (prioritizing grades over conceptual understanding) was reverse-coded to ensure consistent interpretation. The second part included categorical and multiple-response items addressing learning conditions and access, such as device and internet

availability, realistic weekly independent study time, external commitments, and home or dormitory learning environments. In addition, three open-ended questions were included to elicit students' reflections on learning difficulties, effective learning strategies, and expectations of instructional support.

Reliability of the Instrument

The internal consistency of the Likert-scale section of the questionnaire was examined using Cronbach's alpha coefficient. Prior to the analysis, the performance-oriented item prioritizing grades over conceptual understanding was reverse-coded. The reliability analysis showed acceptable internal consistency for the overall 16-item scale ($\alpha = 0.785$). At the construct level, the study habits subscale demonstrated acceptable reliability ($\alpha = 0.735$), whereas motivation and learning goals showed lower internal consistency ($\alpha = 0.491$) and the affective factors subscale also showed lower internal consistency ($\alpha = 0.461$). Given the diagnostic and descriptive purpose of the instrument, the multidimensional nature of the constructs, and the limited number of items per subscale, the subscale scores were interpreted cautiously as descriptive indicators.

Data Collection Procedure

The questionnaire was administered once as an early-semester diagnostic survey. Students completed the instrument during the initial phase of the course to reflect their prior learning habits, affective states, and learning conditions. Participation was voluntary, and responses were used solely for research and instructional improvement.

Data Analysis

Quantitative data were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations. Categorical and multiple-response items were recoded into meaningful categories and summarized as proportions. Qualitative data from open-ended responses were analyzed using thematic analysis, involving familiarization with the data, initial coding, theme development, and theme refinement. Finally, quantitative and qualitative findings were triangulated to generate integrated interpretations and to formulate instructional implications.

3. Research Findings and Discussion

Motivation and Learning Goals

Students' motivation and learning goals at the beginning of the course were examined using descriptive statistics. Table 1 presents the mean scores, standard deviations, and response distributions for the six items representing students' orientation toward conceptual understanding, persistence, and professional relevance as pre-service chemistry teachers.

Table 1. Descriptive Statistics of Students' Motivation and Learning Goals

No.	Item	Mean	SD	Agree (%)	Neutral (%)	Disagree (%)
1	I want to understand chemistry because it is important for becoming a pre-service chemistry teacher.	4.74	0.52	96.23	3.77	0.00
2	My goal in this course is to understand concepts, not merely to pass or obtain high grades.	4.68	0.61	96.23	1.89	1.89
3	I am interested in connecting chemistry concepts with everyday phenomena or school contexts.	4.21	0.77	75.47	24.53	0.00
4	When I encounter difficult	4.08	0.74	77.36	20.75	1.89

No.	Item	Mean	SD	Agree (%)	Neutral (%)	Disagree (%)
	problems, I usually try several approaches before giving up.					
5	I believe that my learning effort strongly influences my learning outcomes.	4.75	0.47	98.11	1.89	0.00
6	Understanding concepts is more important to me than obtaining high grades.	4.00	0.85	75.47	20.75	3.77

As shown in Table 1, students demonstrated a strong mastery-oriented motivational profile, with a high construct mean ($M = 4.40$, $SD = 0.35$) and 92.45% of students categorized in the high range (≥ 4.0). The highest agreement was observed for beliefs that learning effort influences outcomes (98.11%) and that understanding concepts rather than merely passing or obtaining grades is the primary learning goal (96.23%). These results indicate that most students enter the course with intrinsic motivation and a clear professional orientation, which is widely recognized as a positive foundation for deep learning in science education.

Research has highlighted important item-level variations in student experiences of learning chemistry, particularly concerning the relevance of chemistry concepts to everyday life. While students express a positive valuation of contextualized learning ($M = 4.21$), notable neutral responses (24.53%) indicate uncertainty in application across various situations. This phenomenon is consistent with findings in educational literature indicating that when curricula are integrated with real-world contexts, students often display improved comprehension and engagement (Sristy et al., 2023). Moreover, studies have shown that curricula which explicitly incorporate real-world applications can enhance students' achievement and perceptions of relevant chemistry content (Ifat Sristy et al., 2023). These findings point to the necessity of a pedagogical shift that prioritizes learning tasks that directly connect classroom chemistry concepts to students' personal and societal experiences, thereby strengthening their conceptual uptake.

Alongside the contextualization emphasis, persistence in problem-solving remains a critical concern. Although many students demonstrate a commitment to tackling difficult problems, nearly one-fifth of learners remain neutral when faced with challenges. This scenario resonates with the current literature which emphasizes that fostering a supportive learning environment is essential for nurturing perseverance among students (Maglasang et al., 2025). Specifically, innovative instructional strategies, such as project-based learning and graduated complexity in problem sets, have been advocated to scaffold persistence effectively (Hidayah et al., 2025). Further, integrating elements of STEM education not only promotes conceptual understanding but also equips students with the necessary competencies to navigate complex problems in a collaborative manner. Thus, implementing well-structured instructional practices that explicitly foster perseverance through adaptive challenges is crucial for enhancing students' confidence in their problem-solving capabilities in chemistry.

Study Habits

Students' study habits were analyzed to capture the extent to which effective learning strategies are consistently practiced. Table 2 summarizes the descriptive statistics for six items representing routine study behaviors, active learning strategies, reflective practices, and collaborative learning.

Tabel 2. Descriptive Statistics of Students' Study Habits

No.	Item	Mean	SD	Agree (%)	Neutral (%)	Disagree (%)
1	I study chemistry regularly (at least 2–3 times/week), not only before exams.	3.34	0.73	35.85	56.60	7.55
2	I make structured notes/concept maps after lectures.	3.66	0.91	50.94	37.74	11.32
3	When I do not understand, I seek other sources (books/videos/articles) to compare explanations.	4.15	0.77	79.25	18.87	1.89
4	After quizzes/assignments, I evaluate what I got wrong and why.	3.81	0.70	67.92	32.08	0.00
5	I usually discuss in groups to test understanding (not merely to share answers).	3.74	0.97	60.38	30.19	9.43
6	When studying, I practice solving problems and check mistakes (not only reading).	4.02	0.81	75.47	20.75	3.77

Overall, students' study habits were found to be moderately developed ($M = 3.80$, $SD = 0.53$), with a majority categorizing their habits as moderate (52.83%), while only 41.51% displayed consistently high study engagement. However, the least favorable behavior recorded was related to regular study sessions, as indicated by a mean score of ($M = 3.34$), with more than half of the respondents expressing neutral sentiments about their study frequency. This trend suggests that many students have yet to establish stable study routines, which can significantly hamper the cumulative understanding of a complex subject like chemistry. Research indicates that ineffective study habits can correlate with lower academic performance, particularly in challenging courses. Afyusisye & Gakuba (2022) argue that practical work in chemistry promotes positive attitudes, which can influence students' academic performance. This notion aligns with the concept of self-regulated learning, which posits that students who adopt structured study habits are more likely to succeed academically, particularly in content-heavy subjects.

The lack of a consistent study routine has been identified as a barrier to deep learning in the subject matter. Students who do not engage in regular study tend to rely on rote memorization, which is insufficient for mastering intricate concepts. The importance of practical engagement in chemistry education cannot be overstated. Although not directly relevant to the topic, some research highlights the importance of innovative learning materials in improving students' competencies in chemistry (Situmorang et al., 2020). Consequently, integrating structured study practices with practical laboratory experiences could bridge the gap in students' understanding and retention of chemistry concepts. Coupled with innovative instructional strategies, such as project-based learning, educators can enhance students' study habits and foster environments conducive to meaningful learning in chemistry, encouraging greater engagement over time.

In contrast, several active learning behaviors showed strong endorsement. Seeking alternative learning resources when confused ($M = 4.15$; 79.25% agreement) and practicing problem solving while checking mistakes ($M = 4.02$; 75.47% agreement) emerged as clear

strengths. These patterns suggest that students are willing to engage actively when difficulties arise, even if such strategies are not yet embedded in regular routines. Taken together, Table 2 indicates a gap between students' awareness of effective strategies and the consistency with which those strategies are enacted—underscoring the importance of structured scaffolding, such as frequent low-stakes assignments and guided reflection activities.

Affective Factors: Self-Confidence and Anxiety

Students' affective profiles were examined through self-confidence, mathematics confidence, assessment anxiety, and comfort in help-seeking. Table 3 presents descriptive statistics for each affective indicator, while Figure 1 visualizes the distribution of agreement, neutrality, and disagreement across these dimensions.

Table 3. Descriptive Statistics of Affective Factors: Self-Confidence and Anxiety

No.	Item	Mean	SD	Agree (%)	Neutral (%)	Disagree (%)
1	I am confident that I can understand the chemistry content in this course.	3.83	0.90	67.92	22.64	9.43
2	I am confident using basic mathematics (algebra, logs, graphs) for chemistry problems.	3.32	0.96	41.51	41.51	16.98
3	During chemistry quizzes/exams, I often panic and struggle to think clearly.	3.72	0.98	58.49	33.96	7.55
4	I feel comfortable asking questions in class or via chat/forums when I do not understand.	3.49	1.02	47.17	39.62	13.21

The results reveal moderate confidence in understanding chemistry content ($M = 3.83$), but notably lower confidence in using basic mathematics for chemistry problem solving ($M = 3.32$). Almost equal proportions of students agreed and responded neutrally regarding mathematics confidence, indicating uncertainty rather than clear readiness. This pattern is pedagogically significant, as mathematical reasoning is integral to many chemistry topics and may function as a barrier to engagement if not explicitly supported.

Assessment-related anxiety emerges as a significant issue among students, with findings indicating that a substantial percentage (58.49%) experience panic during quizzes or exams, while few students voice disagreement with this sentiment. Such anxiety adversely affects working memory and problem-solving capabilities, potentially causing students to underperform relative to their actual understanding of the subject matter (Gause et al., 2024). This phenomenon is not unique to the field of chemistry; similar patterns have been observed across various academic disciplines, where high-stakes testing environments heighten anxiety levels and impede student performance (Barnett et al., 2021). It is crucial to acknowledge that a moderate level of comfort in asking questions to seek clarification reflects a prevalent hesitation among students. The existence of a substantial neutral group implies that many students feel uncomfortable or uncertain about their right to seek additional support, which could further exacerbate their anxiety levels and hinder their overall learning experiences (Gause et al., 2024).

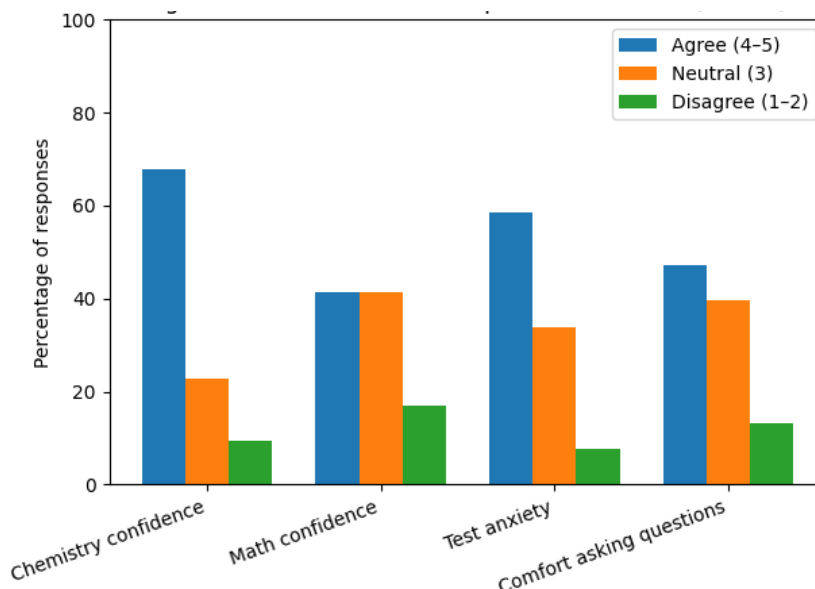


Figure 1. Affective factors: response distribution

Collectively, these affective patterns underscore the pressing need for instructional practices that mitigate evaluative threats, normalize mistakes, and promote psychological safety in the classroom. By creating an environment conducive to open communication and emotional well-being, educators can substantially reduce students’ anxiety surrounding assessments. Literature advocates for comprehensive support systems such as mentoring and targeted skill development programs that equip students with strategies to manage anxiety and promote a growth mindset (Bento et al., 2021). Implementing pedagogical approaches, such as flipped classrooms or enhanced feedback mechanisms, can also facilitate active learning and foster a greater sense of engagement among students, thus reducing anxiety and encouraging a more positive learning environment (Cho & Kim, 2019). These educational strategies are essential for cultivating resilience in students, enabling them to approach assessments with increased confidence and a robust understanding of the material.

Learning Conditions and Access

Students’ learning conditions and access were examined to provide contextual insight into factors that may facilitate or constrain engagement and learning in the chemistry course. Figure 2 presents an integrated overview of students’ access to devices and internet, realistic independent study time per week, home or dormitory learning environments, and commitments outside coursework, offering a contextual baseline for interpreting patterns observed in motivation, study habits, and affective factors.

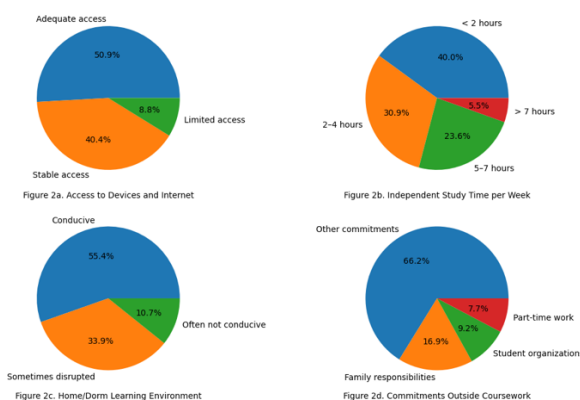


Figure 2. Learning Conditions and Acces

The distributions in Figure 2 indicate that, although most students possess adequate access to learning technology, the quality and stability of this access remain uneven. A considerable proportion relies primarily on smartphones with intermittently unstable internet connectivity, which may limit engagement in learning activities that require sustained attention, simultaneous use of multiple resources, or extensive problem-solving. This technological constraint is compounded by limited realistic independent study time, as the majority of students report four hours or less per week for self-study. Such time limitations help explain why regular study routines were the weakest component of students' study habits, despite their willingness to engage in active strategies such as seeking additional resources and practicing problem solving. These findings underscore the importance of designing learning activities that are time-efficient, mobile-friendly, and structured to promote cumulative learning through short but frequent engagement.

Figure 2 highlights the significant influence of environmental and situational factors on students' learning experiences. A little over half of the students report a conducive study environment at home or in dormitories, but many encounter frequent or occasional disruptions that undermine their concentration and persistence, particularly during cognitively demanding tasks like chemistry problem-solving. This aligns with findings by Mangubat, who emphasized that when students face distractions, their learning outcomes diminish, leading to decreased motivation and performance (Mangubat, 2023). Additionally, the prevalence of external commitments outside of coursework highlights the challenges many students face in balancing academic responsibilities with other obligations, which further increases the likelihood of fragmented study time and heightened cognitive load. According to Sakkir et al. (2023) asynchronous learning models offer flexibility, allowing students to navigate their academic commitments more effectively and create a more balanced approach to their studies.

Qualitative Reflections and Triangulation

Building on the quantitative patterns identified across motivation, study habits, affective factors, and learning conditions, qualitative reflections provide explanatory insight into how students experience early chemistry learning. Overall, students' narratives help clarify why strong motivation and positive learning goals do not always translate into consistent study routines or confident performance, particularly in cognitively demanding contexts. Consistent with the moderate levels of self-confidence and the high prevalence of assessment-related anxiety observed in the survey results, students frequently described difficulties related to conceptual abstraction, instructional pace, and quantitative demands. Many reflections indicate that explanations perceived as too fast or insufficiently detailed make it difficult for students to follow multi-step reasoning, especially when mathematical operations are involved. These experiences help explain the coexistence of high motivation with uncertainty and anxiety, suggesting that affective challenges are closely tied to cognitive load rather than to low effort or disengagement.

In line with the quantitative findings on study habits, students' reflections emphasize active, problem-oriented strategies as their primary means of learning. Repeated practice, discussion with peers, and the use of videos or alternative explanations were commonly mentioned as effective approaches to overcoming confusion. However, qualitative responses also suggest that these strategies are often employed reactively, triggered by difficulty or assessment demands, rather than integrated into regular study routines. This pattern aligns with the survey result showing strong endorsement of active strategies alongside weak consistency in routine studying, highlighting a gap between strategic awareness and habitual practice.

Students' expectations of instructional support connect individual learning behaviors with contextual constraints. The strong demand for clear, step-by-step explanations and accessible learning materials reflects both cognitive needs and practical realities such as limited independent study time, uneven technological access, and variable learning environments. This

assertion is supported by research from Shin et al. (2020) which highlights that well-structured instructional scaffolding provides essential support for learners and enhances their understanding of materials. For students facing fragmented study opportunities, revisitable materials and explicit scaffolding function as critical supports that enable sustained engagement beyond the classroom. These qualitative insights reinforce the idea that learning conditions shape how, when, and to what extent students can enact effective study strategies. Mamun (2022) indicates that structured integration of scaffolding can promote self-regulation and enhance learners' exploration skills during inquiry-based learning processes.

4. Conclusion

This study offers an early diagnostic portrait of chemistry students' learning profiles at the beginning of a course, revealing a coherent yet nuanced pattern across motivational, strategic, affective, and contextual dimensions. The findings show that students enter the course with strong mastery-oriented motivation and positive learning goals; however, these strengths are accompanied by only moderately consistent study habits, limited confidence in mathematical reasoning, and a high prevalence of assessment-related anxiety. Qualitative reflections further clarify that these affective challenges are closely linked to perceived conceptual difficulty, instructional pacing, and quantitative demands, rather than to a lack of effort or engagement. Contextual constraints—including limited independent study time, uneven access to stable technology, variable learning environments, and competing commitments—further shape how students enact learning strategies. Taken together, the results underscore the value of early diagnostic assessment as a foundation for instructional decision-making, highlighting the need for explicit cognitive scaffolding, anxiety-sensitive assessment practices, and flexible, revisitable learning resources that align with students' motivational strengths and lived learning conditions.

5. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

6. Author Contributions

S.S and M. conceptualized the research idea, designed the study, developed the diagnostic questionnaire, collected the data, conducted the initial data analysis, and drafted the manuscript. A.A. contributed to the refinement of the research methodology, data interpretation, discussion of findings, manuscript revision, and final approval of the article. All authors confirm that they have read and approved the final version of this manuscript. The percentage contributions for the conceptualization, drafting, analysis, and revision of this paper are as follows: S.S.: 25, M.: 40% and A.A.: 35%.

7. Data Availability Statement

The authors declare that data sharing is not applicable, as no new data were created or analyzed in this study.

REFERENCES

- Afyusisye, A., & Gakuba, E. (2022). The Effect of the Chemistry Practicals on the Academic Performance of Ward Secondary School Students in Momba District in Tanzania. *Journal of Mathematics and Science Teacher*. <https://doi.org/10.29333/mathsciteacher/12397>
- Al Mamun, M. A. (2022). Fostering Self-Regulation and Engaged Exploration During the Learner-Content Interaction Process: The Role of Scaffolding in the Online Inquiry-Based Learning Environment. *Interactive Technology and Smart Education*.

- <https://doi.org/10.1108/itse-11-2021-0195>
- Barnett, P., Arundell, L.-L., Saunders, R., Matthews, H., & Pilling, S. (2021). The Efficacy of Psychological Interventions for the Prevention and Treatment of Mental Health Disorders in University Students: A Systematic Review and Meta-Analysis. *Journal of Affective Disorders*. <https://doi.org/10.1016/j.jad.2020.10.060>
- Bento, F., Bottino, A. G., Pereira, F. C., de Almeida, J. F., & Rodrigues, F. G. (2021). Resilience in Higher Education: A Complex Perspective to Lecturers' Adaptive Processes in Response to the COVID-19 Pandemic. *Education Sciences*. <https://doi.org/10.3390/educsci11090492>
- Can-Kucuk, D., Gencer, S., & Akkus, H. (2022). Development of pre-service chemistry teachers' pedagogical content knowledge through mentoring. *Chemistry Education Research and Practice*, 23(3), 599–615. <https://doi.org/10.1039/D2RP00033D>
- Cho, M., & Kim, M. Y. (2019). Outcomes and influential factors applying flipped learning methods in a clinical adult nursing practicum. *International Journal of Nursing Practice*, 25(2). <https://doi.org/10.1111/ijn.12724>
- Darmastuti, S., Isfaeni, H., & Komala, R. (2025). STEM-based flipped classroom: Improve students' critical thinking skills and biological literacy in animalia material. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 11(1), 166–178. <https://doi.org/10.22219/jpbi.v11i1.39804>
- Deng, F., Xiao, C., Jia, F., Tian, P., & Zhu, J. (2024). DEVELOPING CHEMISTRY PRESERVICE TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE (PCK) THROUGH THE LEARNING BY COLLABORATIVE DESIGN (LBCD) CURRICULUM MODEL. *Journal of Baltic Science Education*, 23(4), 615–631. <https://doi.org/10.33225/jbse/24.23.615>
- der Merwe, D. van. (2022). Preparing Pre-Service Teachers to Guide and Support Learning in South African Schools. *South African Journal of Childhood Education*. <https://doi.org/10.4102/sajce.v12i1.1163>
- Gause, G., Sehularo, L. A., & Matsipane, M. J. (2024). Coping strategies used by undergraduate first-year nursing students during transition from basic to higher education: a qualitative study. *BMC Nursing*, 23(1), 276. <https://doi.org/10.1186/s12912-024-01938-5>
- Gelabert, A. S., Valente, R., & Duart, J. M. (2020). Profiles of Online Students and the Impact of Their University Experience. *The International Review of Research in Open and Distributed Learning*. <https://doi.org/10.19173/irrodl.v21i3.4784>
- Hidayah, H., Wardani, S., & Sumarni, W. (2025). A Project-Based Learning Student Worksheet Based on STEM and Green Chemistry to Improve Students' Conceptual Understanding and 21st Century Competencies. *Chemined*. <https://doi.org/10.15294/chemined.v14i1.29100>
- Ifat Sristy, S. M., Muteti, C. Z., Vasquez, Y., & Mutambuki, J. M. (2023). Integrating Real-World Contexts and Application Cards Activities in the General Chemistry I Course Increases Students' Achievement Scores and Perceptions of Chemistry Relevance. *Journal of Chemical Education*. <https://doi.org/10.1021/acs.jchemed.3c00516>
- Li, Y., Abad, F. M., & García-Holgado, A. (2022). Exploring Factors Influencing Pre-Service and in-Service Teachers' Perception of Digital Competencies in the Chinese Region of Anhui. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-11085-6>
- Maglasang, J. F., REGALADO, A. R., Espina, E. M., Segotier, H. J., Catanes, M. A., Cerdña, R., Tantog, A. J., & Naparan, G. (2025). Integrating Values in Mathematics: Strategies, Challenges, and a Framework for Junior and Senior High School. *Jelr*. <https://doi.org/10.60027/jelr.2025.1777>
- Mangubat, F. M. (2023). Anecdotes of University Students in Learning Chemistry: A Philippine Context. *Jurnal Pendidikan Ipa Indonesia*. <https://doi.org/10.15294/jpii.v12i1.42120>

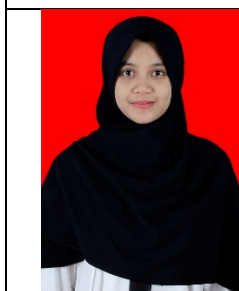
- Martini Meilani, R. S., & Faradiba, Y. (2019). Development of Activity-Based Science Learning Models With Inquiry Approaches. *Jpud - Jurnal Pendidikan Usia Dini*. <https://doi.org/10.21009/10.21009/jpud.131.07>
- Mönch, C., & Markic, S. (2024). Elements Constituting and Influencing in-Service Secondary Chemistry Teachers' Pedagogical Scientific Language Knowledge. *Chemistry Education Research and Practice*. <https://doi.org/10.1039/d3rp00140g>
- Purba, F. J., Sinaga, K., Sitingjak, D. S., & Tahya, C. Y. (2023). 21st Century Chemistry Teacher: Analysis of TPACK of Pre-Service Chemistry Teachers in Teachers College. *Jurnal Pendidikan Kimia*. <https://doi.org/10.24114/jpkim.v15i2.43788>
- Sakkir, G., Trisnawati, I., & Nurfadhilah, A. S. (2023). The Benefits of the Asynchronous Online Learning Model at Post-Pandemic Covid-19: Students' Perception. *Elt Worldwide Journal of English Language Teaching*. <https://doi.org/10.26858/eltww.v10i2.51636>
- Shin, S., Brush, T. A., & Glazewski, K. D. (2020). Examining the hard, peer, and teacher scaffolding framework in inquiry-based technology-enhanced learning environments: impact on academic achievement and group performance. *Educational Technology Research and Development*, 68(5), 2423–2447. <https://doi.org/10.1007/s11423-020-09763-8>
- Sibanda, T., Mbukusa, N. R., & Kwembeya, E. G. (2021). Student Profiling as a Tool for Inclusive Instructional Design: A Case of a 3rd Year Biotechnology Class, University of Namibia. *Frontiers in Education Technology*. <https://doi.org/10.22158/fet.v4n4p12>
- Situmorang, M., Purba, J., & Silaban, R. (2020). Implementation of an Innovative Learning Resource with Project to Facilitate Active Learning to Improve Students' Performance on Chemistry. *Indian Journal of Pharmaceutical Education and Research*, 54(4), 905–914. <https://doi.org/10.5530/ijper.54.4.184>
- Suhaimi, A. F., Ahmad, N., & Kamaruzaman, H. (2024). Examining the Resilience of University Students: A Comparative Mental Health Study. *Cureus*. <https://doi.org/10.7759/cureus.69293>
- Yang, H., Tuo, M., Xu, R., & Hou, S. (2020). PCK Study of Middle School Chemistry Teachers in Yan'an Based on the Core Quality of Chemistry Subject. *Journal of Contemporary Educational Research*, 4(11). <https://doi.org/10.26689/jcer.v4i11.1633>

Author Biographies



Sumiati Side, is a lecturer and researcher at the Chemistry Education Study Program, Faculty of Mathematic and Natural Science, Universitas Negeri Makassar, South Sulawesi, Indonesia. Her research interests include the development of innovative learning models and assessment strategies in chemistry education.

Email: sumiati.side@unm.ac.id



Munawwarah, is a lecturer and researcher at the Chemistry Education Study Program, Faculty of Mathematic and Natural Science, Universitas Negeri Makassar, South Sulawesi, Indonesia. Her research interest is Development of Learning Media With Socio Scientific Issues and ESD approach.

Email: Munawwarah@unm.ac.id



Ayu Ashari, is a lecturer and researcher at the Chemistry Education Study Program, Faculty of Mathematic and Natural Science, Universitas Negeri Makassar, South Sulawesi, Indonesia. Her research interest is Development of Learning Media With Socio Scientific Issues approach. Processes. Email: ayu.ashari@unm.ac.id