Intrinsic Motivation among Pre-Service Chemistry Teachers in Malaysia: Levels and Associations of Interest/Enjoyment with Competence, Autonomy and Relatedness

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ABSTRACT

Intrinsic motivation is important in university chemistry learning because students must engage with abstract concepts, analytical reasoning and practical laboratory work. Guided by Self-Determination Theory, this study examined the level of intrinsic motivation and the relationships between interest/enjoyment and three related constructs (competence, autonomy and relatedness) among pre-service chemistry teachers enrolled as Chemistry Education students at a public teacher-education university in Malaysia. A quantitative survey design was used. From a population of 451 Bachelor of Education (Chemistry) students, a random sample of 210 was selected based on Krejcie and Morgan's (1970) table, and 156 complete responses were obtained (response rate = 74.3%). Data were collected online using a 19-item questionnaire adapted from the Intrinsic Motivation Inventory (IMI) with a 7-point Likert scale. Content validity was established by three experts (I-CVI = S-CVI = 1.00), and Cronbach's alpha values ranged from .90 to .97. Because Shapiro–Wilk tests indicated non-normal distributions, relationships were examined using Spearman's rho. All four constructs were at a high level: interest/enjoyment (M = 5.85, SD = 0.92), relatedness (M = 5.51, SD = 1.78), competence (M = 5.38, SD = 1.09) and autonomy (M = 5.24, SD = 1.70). Interest/enjoyment had a strong, positive and significant relationship with competence (ρ = .694, $p < .001$) and a weak but significant positive relationship with autonomy (ρ = .322, $p < .001$), whereas its relationship with relatedness was positive, very weak and not significant (ρ = .154, p = .055). The findings indicate that these future chemistry teachers generally experience positive intrinsic motivation and that perceived competence is most closely associated with interest/enjoyment. The study offers implications for chemistry educators and teacher-education institutions seeking to build students' sense of competence while providing meaningful choice and social support.

Keywords: intrinsic motivation; Self-Determination Theory; chemistry education; pre-service chemistry teachers; perceived competence

INTRODUCTION

Motivation is a central psychological factor in learning because it influences students' effort, engagement and persistence. In higher education, motivation matters even more because students are expected to take increasing responsibility for their learning, participate actively in academic activities and manage demanding coursework. Within this context, intrinsic motivation refers to engaging in an activity because the activity itself is interesting, enjoyable or satisfying rather than because of external rewards or pressures (Ryan & Deci, 2000). Intrinsically motivated students may therefore approach learning as an activity that is personally meaningful rather than simply as a means of obtaining grades or other external outcomes.

Intrinsic motivation is a pressing concern in chemistry education. University chemistry requires students to work with abstract concepts, theoretical explanations, analytical reasoning, mathematical representations and

laboratory procedures. These demands can make chemistry challenging, and students' perceptions of their learning experiences may influence how willingly and persistently they engage with the subject. A systematic review by Agustian et al. (2022) highlights the complexity of university chemistry laboratory learning and the need to consider students' learning experiences alongside disciplinary outcomes. Research in science education also suggests that inquiry-oriented learning can support students' intrinsic motivation by creating opportunities for active engagement and participation (Meulenbroeks et al., 2024).

Self-Determination Theory (SDT) provides a useful framework for understanding intrinsic motivation. Ryan and Deci (2000) explain that motivation is supported when the basic psychological needs for competence, autonomy and relatedness are fulfilled. Competence concerns feeling capable and effective in dealing with learning tasks; autonomy concerns experiencing a sense of choice and self-direction; and relatedness concerns feeling connected to and supported by other people. Interest/enjoyment is commonly treated as the primary self-report measure of intrinsic motivation in the Intrinsic Motivation Inventory (IMI; McAuley et al., 1989), while competence, autonomy and relatedness provide important contextual and psychological dimensions associated with motivated engagement.

Although intrinsic motivation has been examined across educational contexts, empirical evidence focusing specifically on Chemistry Education students in teacher-education institutions remains limited. Students preparing to become chemistry teachers have a dual role: they must develop their own chemistry knowledge and learning dispositions while also preparing to support learning among their own future students. Understanding their intrinsic motivation therefore bears on both their current university learning and their professional development as future educators.

The present study was conducted at a public teacher-education university in Malaysia to examine the level of intrinsic motivation among Chemistry Education students, who are pre-service chemistry teachers, and the relationships between interest/enjoyment and competence, autonomy and relatedness. The study addresses a context-specific gap by providing empirical evidence from students enrolled in a Chemistry Education programme in Malaysia.

Research Objectives

The study aimed to: (1) determine the level of interest/enjoyment among Chemistry Education students; (2) determine the level of perceived competence; (3) determine the level of perceived autonomy; (4) determine the level of relatedness in the chemistry learning environment; and (5) identify the relationships between interest/enjoyment and competence, autonomy and relatedness.

Research Questions

1. What is the level of interest/enjoyment among Chemistry Education students in chemistry learning?

2. What is the level of perceived competence among Chemistry Education students?

3. What is the level of perceived autonomy among Chemistry Education students?

4. What is the level of relatedness among Chemistry Education students in the chemistry learning environment?

5. Are there significant relationships between interest/enjoyment and competence, autonomy and relatedness?

LITERATURE REVIEW

Intrinsic Motivation and Self-Determination Theory

Intrinsic motivation describes engagement in an activity for its inherent satisfaction rather than for separable consequences. Ryan and Deci (2000) distinguish intrinsic motivation from extrinsic motivation and place both within the broader framework of SDT. From this perspective, the quality of motivation matters because students may participate in the same learning activity for very different reasons. A student who studies chemistry because

the concepts are interesting is experiencing a different motivational quality from a student who studies only to avoid failure or obtain a high grade.

The three basic psychological needs proposed in SDT, namely competence, autonomy and relatedness, apply directly to learning environments. Competence reflects students' feelings of effectiveness and capability. Autonomy reflects a sense of volition and ownership of one's actions. Relatedness concerns a sense of connection with others. When learning environments support these needs, students are more likely to experience self-determined forms of motivation and positive engagement (Ryan & Deci, 2000). In chemistry education, these needs may be supported through appropriate challenge and feedback, opportunities for choice, inquiry-based activities, collaboration and supportive teacher–student relationships.

Intrinsic Motivation in Chemistry Learning

Chemistry presents distinctive motivational challenges because students must coordinate multiple levels of representation and often work with concepts that cannot be directly observed. University chemistry also combines conceptual learning with practical laboratory work. These characteristics can create both intellectual interest and difficulty. Agustian et al. (2022) reported that university chemistry laboratory teaching involves a broad range of learning outcomes and pedagogical demands. Meulenbroeks et al. (2024) further demonstrated the relevance of inquiry-based learning for fostering intrinsic motivation in science learning.

Interest/enjoyment deserves attention because students who find chemistry meaningful or engaging may be more willing to invest effort in challenging learning tasks. Broman et al. (2022) found that affective responses to chemistry problems can be influenced by whether students perceive the content as relevant or interesting. Such evidence supports the view that the way chemistry content is presented can shape students' motivational experiences.

Competence, Autonomy and Relatedness

Perceived competence concerns students' judgments about their ability to understand and successfully perform learning tasks. In chemistry, competence may be influenced by prior learning experiences, feedback, successful laboratory work and opportunities to progressively master difficult concepts. When students perceive themselves as capable, they may be more willing to engage with demanding tasks and sustain their effort. Supportive feedback and opportunities for gradual skill development can strengthen students' perceived competence (Alt et al., 2023).

Autonomy concerns the extent to which students experience choice and self-direction. University students generally have greater responsibility for their learning than school students, but course requirements and assessment structures can still constrain the extent of choice they experience. In chemistry, opportunities to select approaches to tasks, formulate questions, investigate phenomena or make decisions during laboratory activities may support students' sense of ownership. Students who are given opportunities to explore chemistry concepts independently tend to show greater interest and motivation (Archer et al., 2023).

Relatedness concerns students' sense of connection, acceptance and support within their learning environment. This dimension has a clear place in chemistry because laboratory work and collaborative activities frequently involve interaction with peers and instructors. A supportive learning community may help students feel comfortable asking questions, seeking assistance and participating in academic discussions, and students who experience a strong sense of relatedness are more likely to be motivated and engaged in learning activities (Chiu, 2023). However, students' experiences of social connection may differ substantially even within the same learning environment.

Research Gap

Existing research provides evidence that motivation is important in higher education and science learning, although findings may vary across disciplines and learning contexts. However, few studies have specifically examined the level and relationships of intrinsic motivation among Chemistry Education students in Malaysian teacher-education settings. The present study therefore focuses on a defined population of Chemistry Education

students and examines four constructs within a single survey framework. This focus allows the study to describe students' motivational profile and to identify which constructs are most closely associated with interest/enjoyment.

METHODOLOGY

Research Design and Participants

A quantitative survey research design was used to examine the level and relationships of intrinsic motivation among Chemistry Education students at the participating university. The target population consisted of 451 students enrolled in the Bachelor of Education (Chemistry) programme in the 2026 academic year. A sample of 210 students was planned using the sample-size guidance of Krejcie and Morgan (1970). Respondents were selected through random sampling, and the planned sample exceeded the minimum of approximately 205 recommended for this population size at a 95% confidence level and a 5% margin of error. Of the 210 targeted students, 156 returned complete responses suitable for analysis, resulting in a response rate of 74.3%, while 54 students did not respond. The final analysis was therefore based on 156 respondents.

The respondents represented several stages of the programme. Semester 2 students formed the largest group (n = 61, 39.1%), followed by Semester 6 (n = 50, 32.1%), Semester 4 (n = 34, 21.8%), Semester 8 (n = 9, 5.8%), Semester 3 (n = 1, 0.6%) and Semester 7 (n = 1, 0.6%). No respondents were recorded from Semester 1 or Semester 5. This reflected the programme structure: Semester 1 students were at an early stage of their studies and had not yet taken the relevant courses, while Semester 5 students were undertaking their teaching practicum during the data collection period.

In terms of the language of instruction for chemistry learning, 109 respondents (69.9%) reported using bilingual instruction, 39 (25.0%) reported English and 8 (5.1%) reported Bahasa Malaysia. These characteristics provide context for interpreting the findings, although demographic comparisons were not the focus of the present article.

Instrument

Data were collected using a questionnaire adapted from the IMI, a multidimensional measure of individuals' subjective experience of a target activity (McAuley et al., 1989; Ryan & Deci, 2000). The items were contextualised to chemistry learning tasks, translated from English into Bahasa Malaysia by the first author and reviewed by content and language experts to ensure accurate translation and clarity of meaning. The instrument comprised four constructs: interest/enjoyment (five items), competence (five items), autonomy (six items) and relatedness (three items), giving a total of 19 items for the four focal constructs. Responses were recorded on a 7-point Likert scale ranging from 1 ("not at all true") to 7 ("very true"). For the interpretation of construct levels, mean scores of 1.00–3.99 were classified as low, 4.00–4.99 as moderate and 5.00–7.00 as high. Negatively worded items (all six autonomy items and two relatedness items) were reverse-coded before reliability and substantive analyses so that higher scores consistently represented higher levels of the relevant construct.

Validity and Reliability

Content validity was assessed by three experts in chemistry, in line with Lynn's (1986) recommendation that a minimum of three experts is adequate for content validation. Following review and revision of the questionnaire, every item obtained an item-level content validity index (I-CVI) of 1.00 and the scale-level content validity index (S-CVI) was 1.00 (Polit & Beck, 2006), indicating high content validity based on full expert agreement. Internal consistency was examined using Cronbach's alpha with the final study data. As shown in Table 1, the alpha coefficients were .93 for interest/enjoyment, .92 for competence, .97 for autonomy and .90 for relatedness, indicating excellent internal consistency according to the guidelines of Hair et al. (2009). However, coefficients above .90, particularly for autonomy (α = .97), may also indicate some redundancy among items (Tavakol & Dennick, 2011).

Table 1 Internal Consistency of the Intrinsic Motivation Constructs

Construct	Items	Cronbach's α
Interest/enjoyment	5	.93
Competence	5	.92
Autonomy	6	.97
Relatedness	3	.90

Data Collection and Ethics

The questionnaire was administered online via Google Forms to the selected Chemistry Education students. Ethical procedures followed the guidelines for educational research recommended by Cohen et al. (2018). Participation was voluntary. Respondents were informed of the purpose and procedures of the study, could withdraw at any time without academic consequences and were not asked for identifying information such as names or student identification numbers. Confidentiality was maintained, and the information collected was used solely for academic research purposes. The survey involved no physical or psychological intervention. Further details are provided in the Ethical Considerations section.

Data Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS). Frequencies and percentages were used to describe respondent characteristics. Means and standard deviations were calculated for the four intrinsic motivation constructs. Before testing relationships, normality was assessed using the Shapiro–Wilk test, and the distributions were also inspected using normal Q-Q plots, while scatterplots were examined to assess the pattern of the relationships between constructs. All four constructs significantly departed from normality: interest/enjoyment, $W(156) = .929$, $p < .001$; competence, $W(156) = .953$, $p < .001$; autonomy, $W(156) = .888$, $p < .001$; and relatedness, $W(156) = .805$, $p < .001$. Because the normality assumption was not met, Spearman's rho (Pallant, 2020) was used to examine the relationships between interest/enjoyment and the other three constructs. Statistical significance was evaluated at $p < .05$. The strength of each coefficient was interpreted using Evans's (1996) guidelines: .00–.19 = very weak, .20–.39 = weak, .40–.59 = moderate, .60–.79 = strong and .80–1.00 = very strong. Correlations were interpreted in terms of direction and strength, while recognising that correlation does not establish causation.

RESULTS

Levels of Intrinsic Motivation

The descriptive results showed that all four intrinsic motivation constructs were at a high level (Table 2). Interest/enjoyment recorded the highest mean ($M = 5.85$, $SD = 0.92$), followed by relatedness ($M = 5.51$, $SD = 1.78$), competence ($M = 5.38$, $SD = 1.09$) and autonomy ($M = 5.24$, $SD = 1.70$). In other words, respondents reported positive experiences across all four dimensions. The relatively small standard deviation for interest/enjoyment indicates that responses were comparatively consistent, whereas relatedness and autonomy showed greater variation among students.

Table 2 Descriptive Statistics for Intrinsic Motivation Constructs

Construct	*M*	*SD*	Level
Interest/enjoyment	5.85	0.92	High
Relatedness	5.51	1.78	High

Construct	*M*	*SD*	Level
Competence	5.38	1.09	High
Autonomy	5.24	1.70	High

Relationships Between Interest/Enjoyment and Other Constructs

As presented in Table 3, Spearman's rho indicated a strong, positive and statistically significant relationship between interest/enjoyment and competence, ρ = .694, $p < .001$, $n = 156$. This was the strongest relationship identified in the study. A weak but statistically significant positive relationship was also found between interest/enjoyment and autonomy, ρ = .322, $p < .001$, $n = 156$. In contrast, the relationship between interest/enjoyment and relatedness was positive but very weak and did not reach statistical significance, ρ = .154, $p = .055$, $n = 156$.

Table 3 Spearman Correlations Between Interest/Enjoyment and Other Intrinsic Motivation Constructs

Relationship	ρ	*p*	Interpretation
Interest/enjoyment – competence	.694	< .001	Strong, positive, significant
Interest/enjoyment – autonomy	.322	< .001	Weak, positive, significant
Interest/enjoyment – relatedness	.154	.055	Very weak, positive, non-significant

The results indicate that students who reported higher interest/enjoyment also tended to report higher perceived competence. A smaller but significant association was observed with autonomy. Although relatedness had a positive direction of association with interest/enjoyment, the evidence was insufficient to conclude that a statistically significant relationship existed in this sample.

DISCUSSION

High Levels of Intrinsic Motivation

The most notable finding is that all four constructs were rated at a high level. This suggests that the Chemistry Education students in the study generally experienced positive motivational conditions in their chemistry learning. Interest/enjoyment was the highest-rated construct ($M = 5.85$, $SD = 0.92$), indicating that students viewed chemistry learning positively and found their learning activities interesting and enjoyable. This result stands out given the conceptual and practical demands of university chemistry.

The high level of interest/enjoyment is consistent with previous literature emphasising the role of engaging learning experiences in chemistry. Broman et al. (2022) showed that students' affective responses to chemistry problems can be influenced by relevance and interest. Meulenbroeks et al. (2024) similarly highlighted inquiry-based learning as a potential support for intrinsic motivation in science. In the present study, the high interest/enjoyment score should not be interpreted as evidence that a particular teaching method caused the motivation; rather, it indicates that students reported positive motivational experiences within their chemistry learning context.

Competence was also high ($M = 5.38$, $SD = 1.09$). Respondents tended to see themselves as capable of understanding and performing chemistry-related learning tasks. The score is lower than that for interest/enjoyment but remains within the high category. The result is important because chemistry requires students to integrate conceptual knowledge with problem-solving and practical skills. Supportive feedback and opportunities for progressive mastery may help students sustain these perceptions of competence, as suggested by Alt et al. (2023).

Autonomy obtained the lowest mean among the four constructs (M = 5.24, SD = 1.70), although it remained high. This lowest mean should not, however, be read as low autonomy. Instead, it suggests that students' perceptions of autonomy were somewhat less positive than their perceptions of interest/enjoyment, relatedness and competence. One possible contextual explanation is that university chemistry learning operates within course requirements, learning outcomes, assignments and laboratory procedures that necessarily place boundaries on students' choices. Nevertheless, the high overall score indicates that respondents still experienced a reasonable degree of self-direction.

Relatedness recorded a high mean (M = 5.51) but the largest standard deviation (SD = 1.78). Students generally felt connected and supported, but their experiences varied more widely than on the other constructs. The wider spread of scores is understandable, as social experiences can differ between individuals even when students share the same programme and learning environment. Chiu (2023) emphasises the relevance of supportive social relationships to student engagement. In chemistry learning, where laboratory and group activities often require collaboration, creating inclusive opportunities for interaction remains important.

Interest/Enjoyment and Competence

The strongest relationship in the study was between interest/enjoyment and competence (ρ = .694, p < .001). This finding indicates that students who reported higher interest/enjoyment in chemistry learning also tended to report stronger perceptions of competence. The relationship is consistent with the theoretical logic of SDT: feeling capable and effective in an activity can support willingness to engage with and enjoy that activity. It also aligns with Ryan and Deci's (2000) view that feelings of competence are a key condition for sustaining intrinsic motivation.

The strength of this association matters in chemistry, where students often encounter abstract concepts and challenging problem-solving tasks. When students perceive that they can understand and perform chemistry tasks successfully, difficult content may be experienced as more manageable and rewarding. Conversely, repeated difficulty may reduce students' confidence and diminish their enjoyment. However, because the present study is correlational and cross-sectional, the direction of influence cannot be determined. It would be inappropriate to conclude that competence causes interest/enjoyment or that interest/enjoyment causes competence. What the data show is a strong association that deserves closer study.

Interest/Enjoyment and Autonomy

A weak but significant positive relationship was found between interest/enjoyment and autonomy (ρ = .322, p < .001). The relationship was weaker than the association with competence but remained statistically significant. The result is in line with SDT, which proposes that experiences of volition and self-direction support self-determined motivation (Ryan & Deci, 2000), and with evidence that opportunities to explore chemistry independently are linked to greater interest (Archer et al., 2023). When students have opportunities to make choices about how they approach learning tasks, they may be more likely to experience the activity as personally engaging.

The weak strength of this association also suggests that autonomy alone does not explain students' interest/enjoyment. Chemistry learning is structured by curricula, assessments, laboratory requirements and course outcomes, so students may experience only partial choice within a formally organised programme. The finding therefore supports a balanced approach in which educators provide meaningful choices without removing the guidance and structure necessary for learning complex chemistry content.

Interest/Enjoyment and Relatedness

The relationship between interest/enjoyment and relatedness was positive but very weak and not statistically significant (ρ = .154, p = .055). The positive direction is consistent with the theoretical expectation that supportive relationships can contribute to positive learning experiences, but the statistical result does not provide sufficient evidence of a significant association in this sample. It should therefore be interpreted more cautiously than the relationships observed for competence and autonomy.

Several explanations are possible. Students may experience social belonging and academic interest as partly independent aspects of their chemistry learning. A student can enjoy chemistry because of intellectual curiosity or personal interest even when their social experience is not a major contributor. Equally, students may feel well connected to peers or lecturers without necessarily finding chemistry intrinsically enjoyable. The relatively large standard deviation for relatedness also indicates considerable variation in students' social experiences, which may have attenuated its association with interest/enjoyment. Future studies could examine relatedness using more detailed measures of peer support, lecturer support and belonging to the chemistry learning community.

Implications for Chemistry Education

The findings have implications for chemistry lecturers and teacher-education institutions. First, the strong association between competence and interest/enjoyment suggests that learning environments should provide students with opportunities to experience successful engagement with chemistry. Tasks can be scaffolded from accessible to more challenging levels, and feedback can focus on progress and specific aspects of performance. Laboratory and problem-solving activities can be structured so that students have opportunities to develop mastery rather than repeatedly experience failure.

Second, the significant association between autonomy and interest/enjoyment suggests that students may benefit from some degree of choice within structured chemistry courses. Examples include allowing limited choice of experimental approaches, problem-solving strategies, contexts for assignments or ways of presenting learning outcomes. Such choices should remain aligned with course objectives and safety requirements.

Third, although relatedness was not significantly associated with interest/enjoyment, the high mean for relatedness indicates that social connection remains a positive feature of the students' learning environment. Lecturers and institutions can continue to support collaborative learning, peer interaction, accessible lecturer–student communication and inclusive classroom practices. The high variability in relatedness scores suggests that such opportunities should be designed so that students who are less socially connected are also able to participate and receive support.

Limitations

Several limitations should be considered when interpreting the findings. First, the study obtained 156 complete responses from a planned sample of 210, resulting in a 74.3% response rate. The smaller final sample may limit the representativeness of the findings relative to the full population of 451 Chemistry Education students. Second, the study was restricted to the Bachelor of Education (Chemistry) programme at a single university, so the findings should not be generalised automatically to chemistry students in other programmes or universities.

The sample was also unevenly spread across semesters, with most respondents coming from Semesters 2, 4 and 6 and very small numbers from Semesters 3 and 7. There were no respondents from Semesters 1 and 5. Consequently, the findings should not be interpreted as representing equivalent experiences across all stages of the programme. In addition, the study focused on four intrinsic motivation constructs and did not examine other potentially relevant factors such as socioeconomic background, academic achievement, teaching approaches or personal circumstances. Because the data were self-reported, responses reflect students' perceptions and may be influenced by individual interpretation and response tendencies. Furthermore, the relatedness subscale comprised only three items and showed the largest variability among the constructs (SD = 1.78), so it may not have fully captured the multidimensional nature of students' social connectedness in chemistry learning.

Finally, the cross-sectional survey design describes associations at one point in time and does not permit causal conclusions. The correlations reported in this article therefore indicate associations rather than cause-and-effect relationships.

RECOMMENDATIONS FOR FUTURE RESEARCH

Future research could use larger samples and include Chemistry Education students from multiple teacher-education institutions in Malaysia to improve generalisability. Longitudinal studies could examine how intrinsic motivation changes across different stages of a chemistry education programme, particularly before and after

practicum experiences. Researchers could also compare motivational constructs across demographic or academic groups using appropriate inferential tests where sample sizes permit. Qualitative interviews or focus groups could complement survey findings by exploring why students feel competent, autonomous, interested or socially connected in particular chemistry learning situations. Intervention studies could further examine whether inquiry-based learning, context-based chemistry, structured laboratory choice or mastery-oriented feedback can strengthen intrinsic motivation. In terms of measurement, future studies should review the autonomy items to reduce possible redundancy and better capture meaningful choice in chemistry learning, and expand the relatedness scale with more detailed measures of peer support, lecturer support and sense of belonging.

CONCLUSION

This study examined the level and relationships of intrinsic motivation among Chemistry Education students at a Malaysian public teacher-education university. Students reported high levels of all four constructs: interest/enjoyment, competence, autonomy and relatedness. Interest/enjoyment recorded the highest mean, while autonomy recorded the lowest, although both remained within the high category. Interest/enjoyment showed a strong positive relationship with competence and a weak but significant positive relationship with autonomy. Its relationship with relatedness was positive but very weak and not statistically significant.

Taken together, the findings show that the participating Chemistry Education students generally experience positive intrinsic motivation in their chemistry learning. The strong association between interest/enjoyment and competence points to the value of helping students develop a sense of capability when learning challenging chemistry content. At the same time, opportunities for choice and supportive social interaction still matter in a motivating learning environment. The study adds local evidence on intrinsic motivation among future chemistry teachers in Malaysian higher education.

Ethical Considerations

All procedures involving human participants were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments. Before giving consent, participants were briefed on the purpose and procedures of the study and on their right to withdraw at any time without academic consequences. Participation was voluntary, no identifying information such as names or student identification numbers was collected, and all responses were treated confidentially and used solely for academic research purposes. The study posed no foreseeable physical or psychological risk to participants.

Conflict Of Interest

The authors declare no conflict of interest related to this study.

Data Availability

The data are not publicly available because they contain participant responses collected under conditions of confidentiality. The data are available from the corresponding author upon reasonable request, subject to applicable institutional and ethical requirements.

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REFERENCES

1. Agustian, H. Y., Finne, L. T., Jørgensen, J. T., Pedersen, M. I., Christiansen, F. V., Gammelgaard, B., & Nielsen, J. A. (2022). Learning outcomes of university chemistry teaching in laboratories: A systematic review of empirical literature. Review of Education, 10(2), e3360. https://doi.org/10.1002/rev3.3360

2. Alt, D., Naamati-Schneider, L., & Weishut, D. J. N. (2023). Competency-based learning and formative assessment feedback as precursors of college students' soft skills acquisition. Studies in Higher Education, 48(12), 1901–1917. https://doi.org/10.1080/03075079.2023.2217203
3. Archer, L., Francis, B., Moote, J., Watson, E., Henderson, M., Holmegaard, H., & MacLeod, E. (2023). Reasons for not/choosing chemistry: Why advanced level chemistry students in England do/not pursue chemistry undergraduate degrees. Journal of Research in Science Teaching, 60(5), 978–1013. https://doi.org/10.1002/tea.21822
4. Broman, K., Bernholt, S., & Christensson, C. (2022). Relevant or interesting according to upper secondary students? Affective aspects of context-based chemistry problems. Research in Science & Technological Education, 40(4), 478–498. https://doi.org/10.1080/02635143.2020.1824177
5. Chiu, T. K. F. (2023). Student engagement in K-12 online learning amid COVID-19: A qualitative approach from a self-determination theory perspective. Interactive Learning Environments, 31(6), 3326–3339. https://doi.org/10.1080/10494820.2021.1926289
6. Cohen, L., Manion, L., & Morrison, K. (2018). Research methods in education (8th ed.). Routledge.
7. Evans, J. D. (1996). Straightforward statistics for the behavioral sciences. Brooks/Cole.
8. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). Multivariate data analysis (7th ed.). Prentice Hall.
9. Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educational and Psychological Measurement, 30(3), 607–610. https://doi.org/10.1177/001316447003000308
10. Lynn, M. R. (1986). Determination and quantification of content validity. Nursing Research, 35(6), 382–385. https://doi.org/10.1097/00006199-198611000-00017
11. McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. Research Quarterly for Exercise and Sport, 60(1), 48–58. https://doi.org/10.1080/02701367.1989.10607413
12. Meulenbroeks, R., van Rijn, R., & Reijerkerk, M. (2024). Fostering secondary school science students' intrinsic motivation by inquiry-based learning. Research in Science Education, 54(3), 339–358. https://doi.org/10.1007/s11165-023-10139-0
13. Pallant, J. (2020). SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS (7th ed.). McGraw-Hill Education.
14. Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. Research in Nursing & Health, 29(5), 489–497. https://doi.org/10.1002/nur.20147
15. Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68
16. Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd