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Article

Modeling Chemistry Aspirations in High School: A Structural Equation Approach to Self-Efficacy, Learning Approaches, and Self-Regulated Learning

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ABSTRACT
This study aims to (1) identify the best model of relationships among learning self-efficacy, learning approaches, and self-regulated learning on the chemistry aspirations of high school students during the pandemic, and (2) determine the structural equation model (SEM) that best represents these relationships, including the relevant dimensions and indicators for each variable. This quantitative research employed a survey method, path analysis, and SEM approach. The sample consisted of 603 students from the Cirebon district, selected through cluster random sampling. Data were collected using a structured questionnaire. Prior to statistical analysis, prerequisite tests including normality, homogeneity, and outlier detection were conducted. Validity and reliability were examined using Exploratory and Confirmatory Factor Analyses.The findings revealed that the learning approach had the most significant direct association with students' chemistry aspirations, whereas self-efficacy and self-regulated learning showed indirect relationships. Interestingly, surface motives rather than deep strategies—were found to be more strongly linked to chemistry aspirations, suggesting that students' engagement is primarily driven by performance goals and exam success. This context-dependent finding reflects Indonesia's teacher-centered and exam-oriented learning culture. The most influential indicator was students' initiative to use their free time to explore chemistry topics, while the least influential was self-control during unsupervised study. These results highlight the need to design learning strategies that gradually transform surface motives into deeper, intrinsic engagement through reflective, inquiry-based, and feedback oriented learning.

INTRODUCTION

Indonesia continues to enhance the quality of education by emphasizing students' competencies to meet the demands of the twenty-first century (Kemdikbudristek, 2020). This era is characterized by rapid technological advancement and global interconnectivity, making science education essential for national progress and economic competitiveness. However, despite growing global attention to science education, students' interest in science has continued to decline, largely due to negative learning experiences and unsupportive environments (DeWitt et al., 2014). Science achievement depends on a complex interaction of academic and non-academic factors (Kang & Keinonen, 2017). In Indonesia, persistent challenges such as limited teaching resources, inadequate laboratory facilities, and exam-oriented assessment systems (Khoiri et al., 2020) underscore the urgent need to re-evaluate strategies for strengthening science education and fostering students' career aspirations in science.

Science aspirations refer to students' motivation and expectations to engage with science learning and pursue science-related careers (Sheldrake et al., 2017). High school represents a critical period for shaping such aspirations (Tai et al., 2006), yet several studies have shown a steady decline in science interest as students progress through school (DeWitt et al., 2014). Previous research has identified multiple psychological factors influencing science aspirations, including self-concept, intrinsic and utility values (Guo et al., 2017), self-efficacy (Du & Wong, 2019), learning approaches (Mujtaba et al., 2018; Sheldrake et al., 2017), and self-regulated learning (Istriyanti & Simarmata, 2014; Pratiwi & Yuliansyah, 2020).

According to the 2019 PISA results, Indonesia ranked 72nd out of 77 countries, highlighting persistent difficulties in developing students' scientific competence. Academic performance has been shown to be strongly influenced by students' self-efficacy the belief in their ability to accomplish learning tasks successfully (Villafañe et al., 2016). Learners with high self-efficacy tend to persevere and perform better, while those with low self-efficacy are more likely to avoid academic challenges (Margolis & McCabe, 2003; Zeldin et al., 2008). Self-efficacy also shapes students' approaches to learning. Students with high confidence in their abilities are more inclined toward deep learning focusing on understanding and integration—whereas low self-efficacy often correlates with surface learning focused on rote memorization (Phan, 2011; Cano, 2005). Unfortunately, Indonesia's teacher-centered and exam-oriented classroom practices (Syarif, 2017) have tended to reinforce surface learning habits, limiting critical thinking, autonomy, and long-term engagement in science.

Self-regulated learning (SRL), defined as learners' ability to plan, monitor, and evaluate their learning (Zimmerman, 2000), plays a complementary motivational role in sustaining students' academic engagement. Learners who demonstrate higher levels of SRL exhibit persistence and adaptability attributes necessary for developing science aspirations. Research has also shown that learning approaches may act as a mediating mechanism linking motivational and cognitive constructs. For example, Ekici et al. (2014) found that students who actively regulate their learning tend to adopt deeper learning approaches, which in turn enhance academic motivation and outcomes.

However, existing studies have rarely examined how learning approaches function as a mediating pathway between self-efficacy or SRL and students' science aspirations. Most research has treated these constructs separately focusing either on the direct influence of self-efficacy or SRL on achievement, or on general science motivation without clarifying how students' approaches to learning translate these internal beliefs into aspirational outcomes. Moreover, in the Indonesian high school context, where surface learning is still dominant due to exam-oriented instruction (Syarif, 2017), understanding this mediation process becomes crucial. It remains unclear whether learning approaches can serve as a bridge that converts students' confidence and self-regulatory ability into sustained chemistry aspirations under such instructional constraints.

Therefore, this study aims to fill this gap by examining the interrelationships among learning self-efficacy, approaches to learning, and self-regulated learning in influencing chemistry aspirations among Indonesian high school students. Specifically, it applies Structural Equation Modeling (SEM) to (1) identify the most suitable structural model that explains the relationships among these constructs, and (2) determine the mediating role of learning approaches in linking self-efficacy and self-regulated learning with students' chemistry aspirations.

METHODS

Research Design

This study employed a quantitative survey design using the SEM approach. The SEM method was chosen to analyze both direct and indirect relationships among variables, as well as to validate the proposed theoretical model of the relationships between learning self-efficacy, approaches to learning, self-regulated learning, and chemistry aspirations of high school students.

Research Location

The research was conducted in five public senior high schools (SMA Negeri) located in Cirebon Regency, West Java, Indonesia. The participating schools included SMA Negeri 1 Babakan, SMA Negeri 1 Waled, SMA Negeri 1 Ciledug, SMA Negeri 1 Lemah Abang, and SMA Negeri 1 Pabedilan. From each school, three classes were selected, consisting of students from Grade X and Grade XI in the Mathematics and Natural Sciences (MIPA/IPA) stream.

Research Period

The study was carried out during the odd semester of the 2021/2022 academic year, spanning from August 2021 to March 2022.

Material

In SEM, determining an adequate sample size is essential to ensure reliable estimation of model parameters. According to Kline (2015), the recommended ratio between the number of cases (N) and the number of estimated parameters (q) is 20:1. This study involved 21 observed indicators or parameters; therefore, the minimum suggested sample size was $20 \times 21 = 420$ respondents. Using a cluster random sampling technique, this research successfully collected data from 603 students, exceeding the minimum recommended sample size.

In terms of grade-level coverage, the sample was intentionally distributed across three high school levels to ensure representativeness of students' learning stages. The participants consisted primarily of Grade X students, with additional representation from Grades XI and XII. Grade X was prioritized because it represents the stage when students begin to develop chemistry-related aspirations, while Grades XI and XII were included to capture variations related to learning maturity and exposure to more advanced chemistry concepts. This alignment across grade levels ensured that the structural model reflects students' developmental progression in self-efficacy, learning approaches, and self-regulated learning.

Participants were drawn from five public senior high schools (SMA Negeri) in Cirebon Regency, West Java, Indonesia: three classes from SMA Negeri 1 Babakan, two classes from SMA Negeri 1 Waled, two classes from SMA Negeri 1 Ciledug, one class from SMA Negeri 1 Lemah Abang, and one class from SMA Negeri 1 Pabedilan. Schools were selected based on comparable institutional characteristics learning facilities, teacher qualifications, and student demographics to minimize confounding effects due to contextual disparities. Although minor differences across grade levels are natural, the sample composition and random clustering approach ensured balanced representation and model robustness across students' academic progression.

Techniques and Data Collection

Developing an appropriate research instrument is a crucial step in any scientific investigation. Generally, data collection methods include **interviews** (using interview guidelines), **observations** (using checklists), and **measurements or tests** (using test items) (Siyoto & Sodik, 2015, p. 98). In survey research, two fundamental designs are commonly used: **cross-sectional** and **longitudinal**. A cross-sectional survey aims to collect data on current attitudes, opinions, or beliefs at a single point in time, while a longitudinal design is intended to observe individuals' changes over an extended period (Creswell, 2012).

The present study employed a **cross-sectional survey design** within the framework of **SEM**, which integrates statistical modeling approaches from both the social sciences (e.g., psychology and sociology) and econometrics. Accordingly, the variables in this study **science aspirations**, **learning self-efficacy**, **approaches to learning**, and **self-regulated learning** represent psychological constructs that describe students' cognitive and motivational profiles. Given the psychological nature of these variables, the most appropriate data collection technique was the **questionnaire (survey instrument)**. The questionnaire was designed to capture latent variables related to students' learning self-efficacy, learning approaches, and self-regulated learning. A total of **52 items** were developed and distributed to respondents to obtain the required data for analysis.

The measurement process was conducted using a **five-point Likert-type scale** to assess the degree of respondents' agreement with each statement. The scale intervals were as follows:

1=StronglyDisagree,	4=Agree,
2=Disagree,	5=StronglyAgree
3=Neutral,	

Research Procedures

This study followed a structured sequence consistent with the Structural Equation Modeling (SEM) analytical framework to ensure both theoretical soundness and empirical validity. The SEM process involves several key stages: (1) model specification, (2) model identification, (3) measurement selection and data preparation, (4) model estimation and evaluation, and (5) interpretation and reporting Accordingly, the research was implemented through the following sequential phases:

1. **Instrument Development and Content Validation** – The questionnaire items were developed based on established theoretical frameworks for learning self-efficacy, approaches to learning, self-regulated learning, and chemistry aspirations. Expert reviewers evaluated the content validity to ensure conceptual clarity and relevance to each construct.
2. **Pilot Study and Exploratory Factor Analysis (EFA)** – A pilot study was conducted using an independent sample of students who were not included in the main dataset, to empirically test the construct validity and reliability of the newly developed instrument. The pilot data were analyzed using **EFA** in JASP 0.16.1.1.0 to explore the underlying factor structure. Items with low or cross-loadings were revised or removed to improve the psychometric quality of the instrument. This exploratory phase ensured that the factor structure was data-driven before the confirmatory phase..
3. **Instrument Revision and Finalization** – Based on the EFA results, the instrument was revised and finalized for the main data collection.
4. **Research Permission and Sampling** –Research permissions were obtained from five public senior high schools (SMA Negeri) in Cirebon Regency, West Java, namely SMA Negeri 1 Babakan, SMA Negeri 1 Waled, SMA Negeri 1 Ciledug, SMA Negeri 1 Lemah Abang, and SMA Negeri 1 Pabedilan. Participants included students from Grades X and XI of the Mathematics and Natural Sciences (MIPA) program
5. **Main Data Collection and Confirmatory Analysis** – The finalized questionnaire was administered to 603 students through both online (Google Forms) and paper-based distribution. The collected data were subjected to **Confirmatory Factor Analysis (CFA)** using AMOS to verify the factor structure obtained from the EFA and to confirm construct validity and unidimensionality prior to testing the structural model.
6. **SEM Analysis** – After validation of the measurement model, SEM was performed to test the hypothesized relationships among learning self-efficacy, learning approaches, self-regulated learning, and chemistry aspirations. The procedure involved model

estimation, evaluation using fit indices (e.g., GFI, AGFI, RMSEA), and interpretation of direct and indirect effects to test the mediating role of learning approaches.

By clearly separating the pilot (EFA) and main (CFA/SEM) phases each using distinct samples and analytical purposes this study maintained methodological rigor and ensured both the exploratory and confirmatory validity of the model. The overall research flow is summarized in Figure 1.

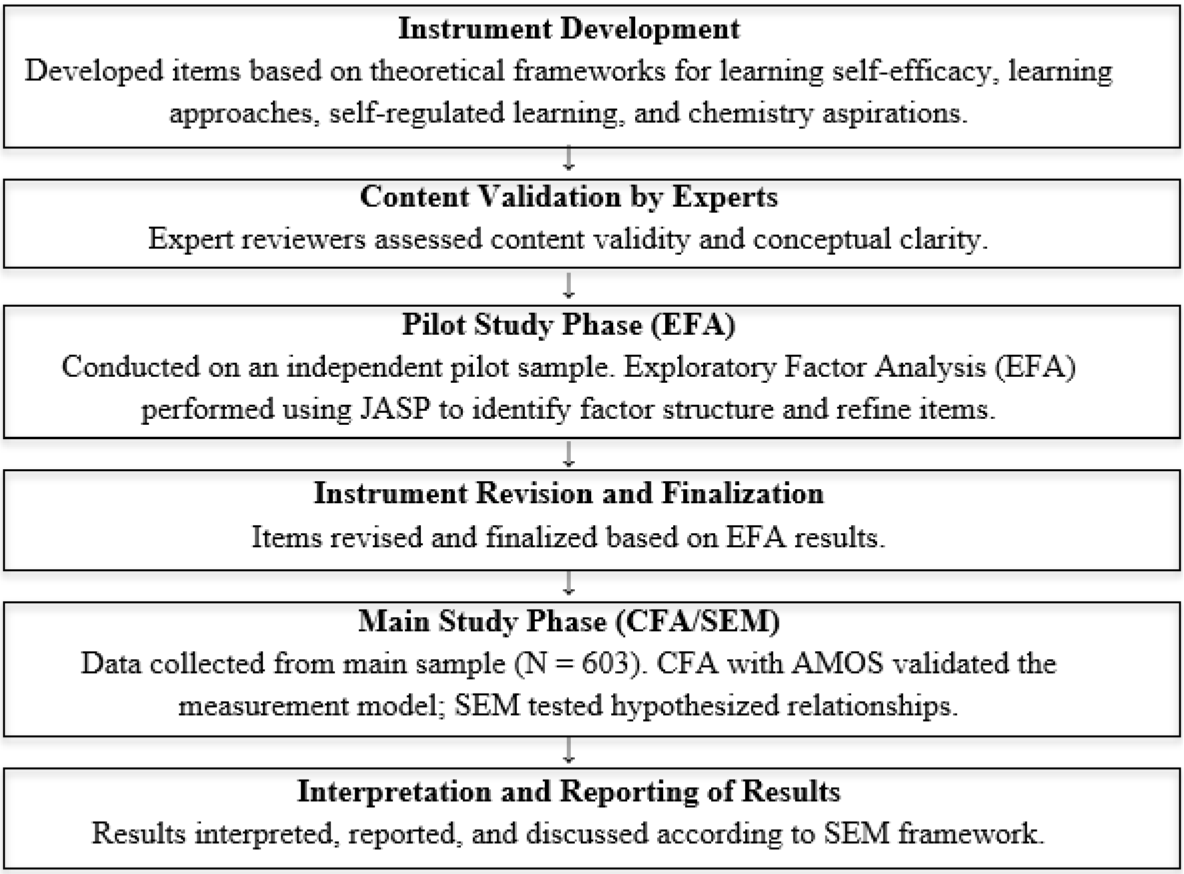

Figure 1. Research Flow

RESULTS AND DISCUSSION

Instrument Trial Analysis

Content Validity

Content validity was evaluated to determine the appropriateness and representativeness of the questionnaire items in measuring the intended constructs. This validity was estimated through a rational analysis conducted by expert judgment. Three experts in science education and educational psychology reviewed all items for clarity, relevance, and alignment with the theoretical framework of the study. Feedback and revision suggestions provided by the experts were documented and used as the basis for improving the quality of the instrument. The suggestions primarily focused on increasing contextual clarity, specifying examples within chemistry learning situations, and refining ambiguous wording. The experts agreed that all items were conceptually relevant and aligned with the constructs being assessed. Based on their input, several revisions were made to enhance linguistic clarity and contextual relevance. Table 1 presents an example of the suggestions and revisions proposed by the expert panel.

Table 1. Expert Judgment Suggestions for Instrument Improvement

Original Item	Expert Suggestion	Accepted/Not Accepted
I found many interesting things that increase my enthusiasm for learning chemistry.	Specify examples, e.g., observable chemical reactions, colorful changes, or energy involvement such as heat and light.	Accepted
Learning chemistry is interesting for me to pursue.	Include phenomena such as color-energy changes or substance transformations to clarify meaning.	Accepted
I believe that participating in chemistry-related extracurricular activities motivates me to choose a career in chemistry.	Add explanation such as "because it broadens my scientific insight."	Accepted
I am active in finding and investigating problems in chemistry learning.	Add example, e.g., through online media such as Google searches or scientific articles.	Accepted
I believe that problems in chemistry learning can only be solved through observation or experimentation to obtain data.	Consider simplifying the wording for clarity without changing meaning.	Accepted
I achieve high chemistry scores through memorization even though I do not fully understand the concepts.	Rephrase slightly for linguistic accuracy: "I achieve high chemistry scores by memorizing, though I do not fully understand the material."	Accepted

All expert feedback was incorporated into the revised instrument, ensuring strong content alignment with theoretical constructs and improved item readability. The final instrument was therefore deemed suitable for empirical testing.

Empirical Validity and Reliability

After instrument revision, empirical testing was conducted through a pilot study. The validity and reliability analyses were performed using IBM SPSS Statistics 22.

Outlier Testing:

Univariate outliers were identified using boxplot analysis, with extreme data points excluded. Multivariate outliers were detected using Mahalanobis distance, where values exceeding χ^2 (0.001, df = 4) = 18.46 were removed. From 150 responses, 17 were excluded, resulting in 133 valid cases.

Normality and Homogeneity Tests:

Multivariate normality and homogeneity tests indicated that the dataset met the assumptions required for Structural Equation Modeling (SEM), confirming that the data distribution was suitable for further analysis.

Reliability Testing:

Cronbach's alpha coefficients across constructs exceeded 0.7, indicating high internal consistency. Similarly, composite reliability (CR) values were above 0.70, and average variance extracted (AVE) values were greater than 0.50, suggesting that the constructs were both reliable and valid (Hair et al., 2014).

Path Analysis and SEM Results

The path analysis and SEM were conducted to evaluate the structural relationships among *learning self-efficacy*, *learning approach*, *self-regulated learning*, and *chemistry aspiration*. The analysis demonstrated that the model was **over-identified** (df > 0), indicating sufficient data for estimation. Using the Maximum Likelihood (ML) estimation method, model fit indices were assessed in the Figure 3 and Table 2.

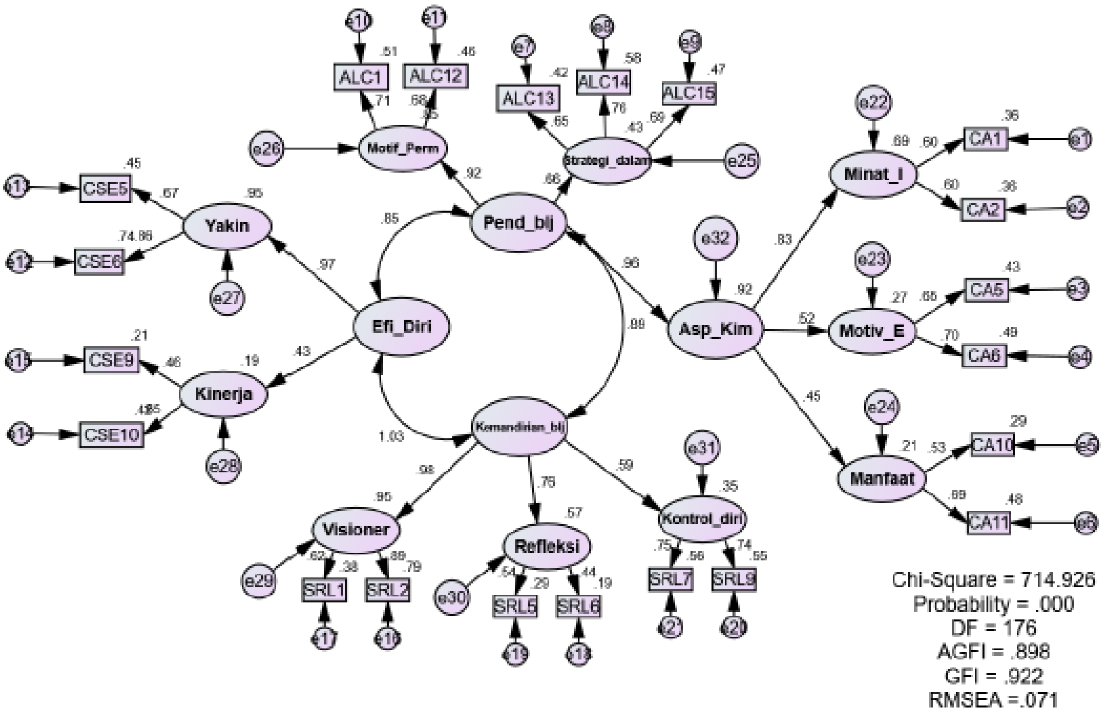

Figure 3. Model 1 SEM

Notes:

Efi_Diri = Self-Efficacy; Yakin = Confidence; Kinerja = Performance; Pend_blj = Learning Approach; Motif_Perm= Continuous Learning Motivation; Strategi_dalam= Instructional Stategy; Kemandirian_blj= Self-Regulated Learning; Visioner = Visionary; Refleksi = Reflection, Kontrol_diri = Self-Control; Asp_Kim = Chemistry Aspiration; Minat_I= Interest , Motiv_E = Extrinsic Motivation; Manfaat = Perceived Career Benefit.

Table 2. Model Fit Indicates

Fit Index	Recommended Value	Obtained Value	Model Fit
GFI	≥ 0.90	0.922	Fit
AGFI	≥ 0.90	0.898	Marginal Fit
RMSEA	≤ 0.08	0.071	Fit

The overall model fit was considered acceptable, with most indices meeting the recommended thresholds. Based on these results, Model 1 was identified as the best-fitting model, indicating that the proposed structural relationships adequately represent the observed data.

Chemistry Aspiration Variable (X_1)

Validity Analysis

The construct validity of the Chemistry Aspiration variable was assessed using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO-MSA) and Bartlett's Test of Sphericity. Table 3 presents the results of the empirical validity analysis.

Table 3. Empirical Validity of Chemistry Aspiration

Test	Statistic	Value	Interpretation
Overall KMO-MSA	0.761	Acceptable (> 0.60)	
Bartlett's Test of Sphericity	$\chi^2 = 272.043$, $p < 0.001$	Significant (< 0.05)	

The KMO-MSA value of 0.761 indicates that the sampling adequacy was within the acceptable range, suggesting that the data were suitable for factor analysis. Additionally, the Bartlett's Test of Sphericity yielded a Chi-square value of 272.043 with p < 0.001, confirming that the correlation matrix was not an identity matrix. According to (Kaiser, 1974), these results demonstrate that the instrument items were appropriate for factor extraction and thus can be considered valid in representing the construct of chemistry aspiration.

Reliability Analysis

Reliability testing for the *Chemistry Aspiration* scale was performed using **Cronbach's Alpha (α)** and the **Average Inter-Item Correlation (AIC)**. The results are summarized in Table 4.

Table 4. Reliability Statistics of Chemistry Aspiration

Reliability Measure	Estimate	95% CI Lower	95% CI Upper	Interpretation
Cronbach's Alpha (α)	0.723	0.649	0.784	Reliable (> 0.70)
Average Inter-Item Correlation (AIC)	0.206	0.158	0.260	Acceptable (0.15–0.50)

The *Cronbach's alpha* value of **0.723** indicates good internal consistency among the items measuring the chemistry aspiration construct. Furthermore, the **average inter-item correlation (0.206)** falls within the ideal range of **0.15 to 0.50** (Martins, 2014), suggesting that the items are moderately correlated and consistently measure the same construct. Based on these results, the *Chemistry Aspiration* instrument is considered **both valid and reliable** for assessing students' aspirations toward chemistry learning and related career interests (Mom, P & Kong, 2024).

Learning Self-Efficacy Variable (X_2)

Validity Analysis

The construct validity of the Learning Self-Efficacy variable was assessed using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO-MSA) and Bartlett's Test of Sphericity to determine the suitability of the data for factor analysis. The results are summarized in Table 5.

Table 5. Empirical Validity of Learning Self-Efficacy

Test	Statistic	Value	Interpretation
Overall KMO-MSA	0.661	Acceptable (> 0.60)	
Bartlett's Test of Sphericity	$\chi^2 = 189.824$, $p < 0.001$	Significant (< 0.05)	

The KMO-MSA value of 0.661 meets the acceptance threshold (Kaiser, 1974), indicating that the data sample was adequate for factor analysis. In addition, the *Bartlett's Test* of Sphericity result ($\chi^2 = 189.824$, $p < 0.001$) was statistically significant, confirming that correlations among the variables were sufficient for factor extraction. Therefore, all items used to measure learning self-efficacy were deemed valid and appropriate for inclusion in the measurement model.

Reliability Analysis

Reliability testing was conducted using *Cronbach's Alpha* (α) and Average Inter-Item Correlation (AIC) to evaluate the internal consistency of the Learning Self-Efficacy scale. The results are presented in Table 6.

Table 6. Reliability Statistics of Learning Self-Efficacy

Reliability Measure	Estimate	95% CI Lower	95% CI Upper	Interpretation
Cronbach's Alpha (α)	0.717	0.639	0.781	Reliable (> 0.70)
Average Inter-Item Correlation (AIC)	0.349	0.190	0.349	Acceptable (0.15–0.50)

The *Cronbach's Alpha* coefficient ($\alpha = 0.717$) indicates good internal reliability, suggesting that the items consistently measure the same construct. Moreover, the average inter-item correlation (AIC = 0.349) lies within the ideal range of 0.15–0.50 (Martins, 2014), confirming moderate and meaningful correlations among items.

Learning Approach Variable (X_3)

Validity Analysis

The validity of the *Learning Approach* variable was assessed through the **Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO-MSA)** and **Bartlett's Test of Sphericity**, which evaluate the suitability of the data for factor analysis. The empirical validity results are shown in Table 7 below.

Table 7. Empirical Validity of Learning Approach

Test	Statistic	Value	Interpretation
Overall KMO-MSA	0.720	Acceptable (> 0.60)	
Bartlett's Test of Sphericity	$\chi^2 = 359.996$, $p < 0.001$	Significant (< 0.05)	

The **KMO-MSA value of 0.720** indicates that the sampling adequacy was satisfactory and met the acceptance criteria suggested by (Kaiser, 1974), The **Bartlett's Test of Sphericity** yielded a **Chi-square value of 359.996 with p < 0.001**, confirming that the correlation matrix was not an identity matrix and that the items were suitable for factor extraction. Based on these results, the questionnaire items were considered to have **good construct validity** and were deemed appropriate for inclusion in further SEM analysis (Syauqi, S, 2024).

Reliability Analysis

Reliability testing was performed using *Cronbach's Alpha* (α) and Average Inter-Item Correlation (AIC) to measure the internal consistency of the *Learning Approach* variable. The results are presented in table 8 below.

Table 6. Reliability Statistics of Learning Approach

Reliability Measure	Estimate	95% CI Lower	95% CI Upper	Interpretation
Cronbach's Alpha (α)	0.732	0.660	0.792	Reliable (> 0.70)
Average Inter-Item Correlation (AIC)	0.306	0.179	0.306	Acceptable (0.15–0.50)

The *Cronbach's Alpha* coefficient ($\alpha = 0.732$) demonstrates a satisfactory level of reliability, exceeding the minimum threshold of 0.70, which indicates that the items consistently measure the same construct. The Average Inter-Item Correlation (AIC = 0.306) also falls within the acceptable range of 0.15–0.50 (Martins, 2014), implying that the items are moderately correlated and effectively represent the underlying dimension of learning approach. Therefore, the *Learning Approach* scale used in this study is considered both valid and reliable, accurately capturing the students' tendencies toward surface or deep learning strategies during the chemistry learning process.

Structural Model Analysis

The structural model analysis identified Model 1 as the best-fitting model, with a significant probability ($p < 0.05$) and an R^2 value of 0.36, indicating that approximately 36% of the variance in chemistry aspiration was associated with the predictors included in the model. It is important to emphasize that these results represent associational rather than causal relationships, as the SEM analysis was conducted using cross-sectional data (Maghribi, A. N., & Aristiawan, 2023). Therefore, the interpretation focuses on patterns of co-occurrence and contextual alignment among the observed variables rather than on directional cause–effect mechanisms.

Within this framework, the findings suggest that surface motives although typically regarded as less desirable in Western educational perspectives may serve as adaptive motivational drivers in contexts where academic success is predominantly measured through standardized tests and rote-based assessments. This contextual reality helps explain why surface motives emerged as a stronger predictor of chemistry aspirations in this study. Students' aspirations to pursue chemistry may stem more from performance-related goals, such as achieving high exam results or receiving teacher recognition, than from intrinsic scientific curiosity or conceptual understanding. Thus, the finding does not necessarily contradict theoretical expectations; rather, it highlights how contextual and systemic factors particularly Indonesia's teacher-centered and exam-oriented classroom culture shape the manifestation of learning motivation and aspiration within a specific educational setting.

Self-efficacy and self-regulated learning, meanwhile, demonstrated indirect associations through the learning approach pathway. Self-efficacy showed a strong link with learning approach ($\beta = 0.85$) and indirectly influenced chemistry aspiration ($\beta = 0.96$). The belief dimension contributed most strongly ($\beta = 0.97$), whereas the performance dimension was weaker ($\beta = 0.43$). Similarly, self-regulated learning was dominated by the visionary dimension ($\beta = 0.98$), with item SRL2 ($\beta = 0.89$) as the strongest indicator. These associations indicate that students with higher confidence and stronger self-regulatory habits tend to adopt more structured learning approaches, which in turn relate to higher chemistry aspirations.

These findings emphasize that motivational processes in Indonesian classrooms are closely tied to contextual realities, such as exam-oriented and teacher-centered practices. While deep learning remains the long-term goal, surface motives currently function as practical drivers for engagement. Therefore, curriculum design and teaching strategies should focus on (1) integrating problem-solving and mini-project tasks aligned with national assessments to make surface motives academically meaningful; (2) embedding metacognitive prompts in lesson plans to foster gradual self-regulation; (3) using formative feedback cycles and peer assessment to strengthen confidence and autonomy; and (4) incorporating contextual, locally relevant chemistry experiments to connect classroom learning with real-life applications. These steps can progressively transform surface motives into intrinsic, curiosity driven engagement while remaining feasible within Indonesia's existing educational framework.

Research Limitations

This study is limited by The subjectivity of self-report questionnaires, The focus on intrinsic factors only, excluding external influences such as teacher and parental support and The absence of qualitative insights, which future research should integrate for deeper understanding.

CONCLUSION

This study identified associative relationships among self-efficacy, self-regulated learning, and learning approaches in shaping students' chemistry aspirations. The results highlight that learning approach was the most strongly associated factor, with surface motives showing a stronger link to chemistry aspirations than deep strategies. This counterintuitive finding reflects Indonesia's teacher-centered and exam-oriented educational culture, where external evaluations often drive students' engagement. Scientifically, this study contributes a context-specific model explaining how motivational and cognitive constructs co-occur in shaping academic aspirations. Practically, it suggests that teachers can utilize surface motives as entry points to promote engagement while gradually encouraging deeper learning through inquiry-based experiments, reflective activities, and formative feedback. Strengthening students' self-regulation and teacher capacity for concept-driven instruction can further enhance chemistry aspirations within exam-driven school environments.

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