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Research Article

Mapping the Diversity of Independence Learning Among Senior High School Students: A Latent Profile Analysis

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Mapping the Diversity of Independence Learning Among Senior High School Students: A Latent Profile Analysis

Abstract. Independence Learning helps senior high school students manage their learning. This study aimed to identify heterogeneity in Independence Learning across six dimensions: learning goals, planning, monitoring, execution, evaluation, and reflection. A person-centered approach used

Latent Profile Analysis (LPA). Participants were 277 senior high school students, including 100 males and 177 females. Data were collected using 25 Independence Learning items from an existing instrument. Mean scores for each dimension were standardized and analyzed with tidyLPA and mclust in R. Solutions containing one to six profiles were compared using fit and classification indices. The four-profile solution yielded the lowest *Bayesian Information Criterion* (BIC = 4311.011) and an entropy value of 0.832. Profile 1 included 56 students (20.2%) with low monitoring and execution scores. Profile 2 comprised 12 students (4.3%) who scored highly across all dimensions. Profile 3 was the largest group, comprising 143 students (51.6%), with balanced, moderate scores. Profile 4 included 66 students (23.8%) with strong planning and evaluation scores. These findings indicate that effective learning planning does not necessarily correspond to equally strong monitoring and implementation. The identified profiles provide a basis for designing differentiated instructional support. However, the small size of one profile limits generalization and warrants replication.

Keywords: Independence Learning; Latent Profile Analysis; Student Heterogeneity; Self-Regulated Learning; Senior High School Students.

Abstrak. Kemandirian belajar membantu siswa SMA mengarahkan, melaksanakan, dan mengevaluasi kegiatan belajarnya. Penelitian ini bertujuan mengidentifikasi heterogenitas kemandirian belajar siswa berdasarkan enam dimensi, yaitu tujuan belajar, perencanaan, pemantauan, eksekusi, evaluasi, dan refleksi. Penelitian kuantitatif ini menggunakan *Latent Profile Analysis* (LPA). Partisipan terdiri atas 277 siswa SMA, terdiri atas 100 laki-laki dan 177 perempuan. Data diperoleh menggunakan 25 item instrumen kemandirian belajar dari instrumen terdahulu. Skor rata-rata setiap dimensi distandardisasi sebelum dianalisis menggunakan paket tidyLPA dan mclust dalam R. Solusi satu hingga enam profil dibandingkan berdasarkan kecocokan dan klasifikasi. Hasil menunjukkan bahwa solusi empat profil memiliki nilai *Bayesian Information Criterion* terendah (BIC = 4311,011) dan *entropy* sebesar 0,832. Profil pertama mencakup 56 siswa (20,2%) dengan kelemahan menonjol pada pemantauan dan eksekusi. Profil kedua mencakup 12 siswa (4,3%) dengan skor tinggi pada seluruh dimensi. Profil ketiga merupakan kelompok terbesar, yaitu 143 siswa (51,6%), dengan skor menengah yang seimbang. Profil keempat terdiri atas 66 siswa (23,8%) dengan skor kuat pada perencanaan dan evaluasi. Temuan ini memperlihatkan bahwa perencanaan belajar yang baik tidak selalu disertai pemantauan dan pelaksanaan yang sama kuat. Hasil penelitian memberikan dasar bagi pengembangan dukungan pembelajaran yang mempertimbangkan karakteristik setiap profil. Namun, ukuran profil terkecil yang terbatas membatasi generalisasi dan memerlukan replikasi.

Kata Kunci: Kemandirian Belajar; Analisis Profil Laten; Heterogenitas Siswa; Regulasi Diri dalam Belajar; Siswa SMA.

INTRODUCTION

Independence Learning is an essential competence that enables students to actively and responsibly direct, manage, and evaluate their learning activities. In educational psychology, this competence is closely associated with self-regulated learning, which involves regulating goals, strategies, behaviors, and self-monitoring processes to achieve desired learning outcomes (Dörrenbächer Ulrich & Bregulla, 2024). Independence Learning requires students not only to initiate learning

activities autonomously but also to sustain their efforts and adjust strategies when encountering difficulties. Recent research indicates that planning, monitoring, evaluation, and reflection are important processes that should be developed in an integrated manner throughout secondary education (Pedrosa et al., 2026). Therefore, understanding Independence Learning requires consideration of the relationships among multiple regulatory competencies employed throughout the learning process.

At the senior high school level, Independence Learning becomes increasingly important because students face academic demands requiring greater autonomy in time management, priority setting, and strategy selection. A study of Indonesian senior high school students in physics education demonstrated that several self-regulated learning components were relatively well developed, whereas effort regulation, critical thinking, and test anxiety required further attention (Irsalina et al., 2025). These differences indicate that students who demonstrate relatively strong learning motivation do not necessarily possess equally developed competencies for managing all aspects of their learning activities. A recent meta-analysis also identified a positive association between self-regulated learning strategies and academic achievement in online and blended learning environments, although the overall relationship was relatively small (Zhao et al., 2025). Such evidence highlights the importance of conceptualizing Independence Learning as a set of interconnected competencies rather than a single characteristic uniformly developed across students.

Conceptually, the present study examines Independence Learning through six dimensions: learning goals, planning, monitoring, execution, evaluation, and reflection. Learning goals and planning represent students' preparation before engaging in learning activities, whereas monitoring and execution concern behavioral regulation during task performance. Evaluation and reflection enable students to review their learning processes and outcomes as a basis for improving subsequent learning strategies. A recent systematic review of pedagogical interventions in secondary education emphasized that planning, monitoring, reflection, and feedback can be strengthened through structured instructional support (Pedrosa et al., 2026). Furthermore, research examining the relationship between executive functions and self-regulated learning highlights the importance of metacognitive processes and measurement differences in understanding students' regulatory competencies (Dörrenbächer Ulrich & Bregulla, 2024).

Previous empirical research has demonstrated that students' Independence Learning varies according to educational contexts and the specific competencies being examined. Irsalina et al. (2025) employed Rasch analysis to investigate self-regulated learning among 72 eleventh-grade students in physics education in Bandung, Indonesia, identifying predominantly moderate regulatory abilities alongside differences in strengths and weaknesses across components. In another

context, Keumala et al. (2026) investigated senior high school students' learning autonomy when using artificial intelligence in English language classrooms across three schools in Banda Aceh, revealing differences in autonomous learning behaviors between schools. Torres & Duarte (2024) also demonstrated that peer observation can encourage self-feedback and reflection among secondary school students. Although these studies provide valuable evidence regarding the characteristics and development of Independence Learning, they did not specifically identify latent student subgroups based on the combined configuration of six Independence Learning dimensions.

Other studies have emphasized that students' ability to regulate learning activities is associated with broader psychological characteristics and educational experiences. Through a systematic review of 19 studies, identified predominantly low-to-moderate associations between executive functions and self-regulated learning and highlighted the potential mediating role of metacognition (Dörrenbächer Ulrich & Bregulla, 2024). Zhao et al. (2025) conducted a meta-analysis of 42 studies reported in 37 articles and found a small positive association between self-regulated learning strategies and academic achievement in online and blended learning settings. Meanwhile, Fahrni et al. (2025) reviewed 45 studies examining teachers' use of digital technology to promote students' self-regulated learning and metacognition, emphasizing the value of combining digital support with conventional instructional practices. Although these findings provide important insights into factors associated with learning regulation, they do not explain how distinct combinations of regulatory competencies form multidimensional subgroups of students.

Understanding differences in students' learning characteristics is also essential for developing instructional support that responds to individual learning needs. Torres & Duarte (2024) demonstrated that peer observation activities can facilitate reflection and self-feedback, providing one example of instructional support for self-regulated learning. Fahrni et al. (2025) identified various teaching practices, including instruction, coaching, scaffolding, and feedback, that can be employed to promote students' regulatory and metacognitive competencies. Pedrosa et al. (2026) further reported that interventions supporting self-regulated learning in secondary education incorporate diverse pedagogical approaches, although differences in research designs and measurement practices limit conclusions about the comparative effectiveness of these strategies. Consequently, identifying students' regulatory characteristics before designing instructional support may help educators target the dimensions of Independence Learning that require the greatest attention.

Despite the contributions of these seven studies, an important research gap remains in the identification of multidimensional heterogeneity in Independence Learning among senior high school students. Previous research has primarily examined overall regulatory competencies or differences between components

within particular subjects, autonomous learning behaviors in digital environments, self-feedback, associations with executive functions and academic achievement, and strategies for instructional support. Although these approaches offer valuable insights, the literature examined in the present study did not specifically identify configurations of learning goals, planning, monitoring, execution, evaluation, and reflection as simultaneous indicators in a Latent Profile Analysis (LPA) of Indonesian senior high school students. This gap is important because students with relatively similar overall scores may exhibit different strengths and weaknesses across dimensions, which may remain obscured when Independence Learning is classified using broad categories. Accordingly, a person-centered approach is needed to provide a more detailed understanding of Independence Learning heterogeneity and establish an empirical basis for instructional support that accommodates differences in students' regulatory characteristics.

To address this gap, the present study aims to identify latent profiles of Independence Learning among 277 senior high school students using six dimensions: learning goals, planning, monitoring, execution, evaluation, and reflection. Employing LPA, the study seeks to determine the number of profiles supported by the data, describe the characteristics of each profile, and compare regulatory patterns across the preaction, action, and postaction phases. The findings are expected to extend current understanding of heterogeneity in senior high school students' Independence Learning and inform the development of instructional approaches that are more responsive to diverse learning needs.

METHOD

Research Design

This study employed a quantitative, person-centered approach to investigate heterogeneity in Independence Learning among senior high school students. Unlike variable-centered approaches that primarily examine associations across an entire sample, a person-centered approach identifies subgroups with similar patterns across multiple indicators. Latent profile analysis (LPA), a model-based mixture technique for continuous indicators, was applied to identify unobserved groups based on six dimensions of Independence Learning. The analytical approach was informed by the person-centered investigation of self-regulated learning reported by Schel and Drechsel (2025), while retaining the construct and indicators used in the present study.

Participants

The analytical sample comprised 277 senior high school students with complete responses to all 25 questionnaire items. Of these participants, 100 were

male (36.10%) and 177 were female (63.90%). Grade 10 accounted for the largest share of respondents (n = 158; 57.04%), followed by Grade 11 (n = 96; 34.66%) and Grade 12 (n = 23; 8.30%). All 277 records were retained for descriptive analyses and LPA because no missing item responses were identified in the dataset.

Table 1. Demographic Characteristics of Participants (*n* = 277)

Characteristic	Category	Frequency (*n*)	Percentage (%)
Gender	Male	100	36.10%
	Female	177	63.90%
	Total	277	100%
Grade level	Grade 10	158	57.04%
	Grade 11	96	34.66%
	Grade 12	23	8.30%
Total		277	100%

Research Instrument

Independence Learning was measured using items based on the instrument developed by Zafrullah et al. (2023), which originally addressed six conceptual dimensions: learning goals, planning, monitoring, execution, evaluation, and reflection. In that instrument-development study, content validity was assessed through expert judgment using the Content Validity Ratio (CVR). The authors reported CVR values ranging from 0.20 to 1.00 and interpreted their content-validity assessment as meeting the criteria adopted in their study. These values are cited here as evidence from the earlier development study, rather than as evidence that the adapted item set used in the present sample underwent a new expert-based CVR evaluation.

For the present analysis, 25 items were organized into six dimensions: learning goals (five items), planning (four items), monitoring (three items), execution (four items), evaluation (four items), and reflection (five items). Each dimension score was calculated as the mean of its constituent item responses, producing six continuous indicators for LPA. This selection represents the operationalization used in the present dataset and should not be equated with an independently revalidated version of the original instrument. The six dimension scores were retained separately to capture distinct patterns of Independence Learning rather than reducing the construct to a single composite score.

Table 2. Dimensions and Items Used in the Present Analysis

Dimension	Item codes	Number of items
Learning goals	TB1–TB5	5
Planning	PE1–PE4	4
Monitoring	P1–P3	3
Execution	EK1–EK4	4
Evaluation	EV1–EV4	4
Reflection	RF1–RF5	5
Total		25

Data Analysis

Data analyses were conducted in R using the tidyLPA and mclust packages for model estimation and evaluation. Preliminary analyses examined missingness, descriptive statistics, distributional diagnostics, and Pearson correlations among the six dimension scores. Before profile estimation, the indicators were standardized to z-scores to account for differences in their observed variability. Solutions containing one through six latent profiles were estimated using maximum likelihood, with the same model specification applied across the candidate solutions.

The analysis used Model 1 in tidyLPA, which constrains indicator variances to equality across profiles and fixes within-profile indicator covariances to zero. Candidate models were compared using the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and sample-size-adjusted BIC (SABIC), for which smaller values indicate preferable relative fit under the respective criteria. Bootstrap likelihood ratio tests (BLRTs) were examined to assess improvements when moving from a k − 1 profile solution to a k-profile solution. Model selection additionally considered entropy, average posterior classification probabilities, class proportions, parsimony, and the substantive interpretability of the resulting profiles.

Following model comparison, assigned profile membership was summarized using class frequencies and percentages. Profiles were characterized using mean scores on the original response scale so that their relative strengths and weaknesses across the six dimensions could be interpreted directly. Line plots were used to visualize the configurations of Independence Learning indicators across the selected profiles. Gender and grade level were used only to describe the sample and were not included as profile indicators, covariates, or distal outcomes.

Table 3. Overview of the Analytical Procedure

Stage	Analytical procedure	Purpose
Data screening	Missing-response checks	Establish completeness of the analytical sample
Preliminary description	Descriptive statistics and correlations	Describe distributions and indicator associations
Profile estimation	Standardized six-indicator LPA; 1–6 profiles	Estimate alternative latent structures
Model comparison	AIC, BIC, SABIC, BLRT	Compare relative model fit
Classification assessment	Entropy, posterior probabilities, class sizes	Evaluate separation and group adequacy
Profile interpretation	Original-scale means and line plots	Describe substantive patterns

Supplementary Description of Learning Phases

As a supplementary descriptive exercise, the six dimensions were grouped into three conceptual phases of learning regulation. Learning goals and planning represented the pre-action phase, monitoring and execution represented the action phase, and evaluation and reflection represented the post-action phase. Phase means were obtained by averaging the two constituent dimension scores within each assigned profile, allowing the relative prominence of the three phases to be described. This grouping was an interpretive adaptation informed by the cyclical account of self-regulated learning and was not tested as a separate measurement or latent-profile model.

Table 4. Conceptual Grouping of Independence Learning Dimensions

Learning phase	Dimensions	Interpretive focus
Pre-action	Learning goals; Planning	Setting objectives and preparing learning activities
Action	Monitoring; Execution	Carrying out and monitoring learning activities
Post-action	Evaluation; Reflection	Evaluating and reviewing learning experiences

Ethical Considerations and Data Protection

Because the study concerns senior high school students, the reporting and handling of participant information require particular attention to privacy and confidentiality. The analytical results are presented in aggregate form, including

frequencies, percentages, profile-level means, and model-fit statistics, without publishing names or other direct personal identifiers. Access to the underlying student-level dataset should be restricted to authorized researchers, and any potentially identifying variables should be excluded from publicly shared analysis files. Aggregated reporting reduces disclosure risk but does not, by itself, establish that institutional ethics approval or participant consent was obtained.

The available research materials do not establish the name of an ethics review committee, an approval number, or the specific consent and assent procedures used during data collection. Accordingly, no claim of formal ethical clearance, parental permission, or institutional exemption is made in this manuscript draft. Before submission, the authors should insert an accurate statement describing the approvals, permissions, and participant information procedures actually followed, including any requirements applicable to minors. This distinction ensures that privacy protections are described without making unsupported assertions about ethical authorization.

RESULTS

1. Descriptive Statistics of Independence Learning

Descriptive statistical analysis was conducted to provide an initial overview of high school students' Independence Learning across the six dimensions examined in this study. The means, standard deviations, and observed score ranges are presented in Table 5 to characterize the data before latent profile analysis.

Table 5. Descriptive statistics for the dimensions of Independence Learning

Dimension	N	Mean	SD	Min	Max
Learning Goals	277	2.81	0.35	1.60	4.00
Planning	277	3.13	0.38	1.75	4.00
Monitoring	277	2.81	0.49	1.33	4.00
Execution	277	2.91	0.42	1.50	4.00
Evaluation	277	2.86	0.43	1.75	4.00
Reflection	277	2.85	0.34	2.00	4.00

As shown in Table 1, planning had the highest mean score (M = 3.13, SD = 0.38). This finding suggests that students' capacity to organize learning activities was relatively more pronounced than their capacities in the other dimensions. Within the context of Independence Learning, planning reflects students' readiness to structure their learning activities before engaging in academic tasks. Its comparatively high score therefore suggests stronger preparation-related tendencies than comprehensive self-management across all phases of learning.

In contrast, learning goals and monitoring shared the lowest mean score (M = 2.81). This pattern indicates that defining learning directions and tracking learning progress were relatively less prominent than planning. Monitoring also showed the greatest dispersion (SD = 0.49), suggesting more substantial between-student variation in this dimension. Consequently, students who report relatively strong planning tendencies do not necessarily demonstrate equally strong monitoring skills. Such variation provides a rationale for examining whether distinct groups of students exhibit different configurations of Independence Learning.

2. Relationships Among the Dimensions of Independence Learning

Correlation analysis was performed to examine associations among the six dimensions used as latent profile indicators. This analysis provides preliminary information about their interrelationships before the dimensions are jointly incorporated into the LPA model.

Table 6. Correlation matrix for Independence Learning dimensions

Dimension	LG	PL	MO	EX	EV	RE
LG	1.000					
PL	0.517	1.000				
MO	0.475	0.450	1.000			
EX	0.488	0.510	0.679	1.000		
EV	0.502	0.593	0.478	0.571	1.000	
RE	0.164	0.356	0.193	0.242	0.282	1.000

Note. LG = Learning Goals; PL = Planning; MO = Monitoring; EX = Execution; EV = Evaluation; RE = Reflection.

All six dimensions were positively correlated, with coefficients ranging from 0.164 to 0.679. The strongest association was observed between monitoring and execution (r = 0.679). This result suggests that students who more consistently monitor their learning also tend to report stronger execution of learning activities. Conceptually, monitoring involves tracking progress, whereas execution concerns carrying out planned activities; these processes may therefore reinforce one another.

The weakest association occurred between learning goals and reflection (r = 0.164). This relatively small coefficient suggests that having clear learning goals does not necessarily coincide with a similarly strong tendency to reflect on learning experiences. Students may be able to specify their academic objectives without consistently reviewing how they learn or what they have achieved. None of the observed correlations reached 0.80, indicating that the dimensions were not extremely highly correlated. These associations support their usefulness as potentially distinct sources of profile information, although correlations alone do not establish construct validity.

3. Selection of the Latent Profile Model

One- through six-class solutions were estimated using maximum likelihood under the equal-variance, zero-within-class-covariance specification. Model selection considered statistical fit, classification quality, model parsimony, and the substantive interpretability of the resulting profiles.

Table 7. Fit indices for the one- to six-profile solutions

Classes	AIC	BIC	SABIC	Entropy	BLRT p
1	4734.54	4778.03	4739.98	—	—
2	4405.65	4474.50	4414.26	0.823	0.0099
3	4242.43	4336.65	4254.21	0.836	0.0099
4	4191.42	4311.01	4206.37	0.832	0.0099
5	4204.15	4349.11	4222.28	0.700	0.9901
6	4165.40	4335.73	4186.70	0.873	0.0099

The BIC decreased from the one-class through the four-class solution and reached its minimum at four classes (BIC = 4311.01). This suggests that the four-class solution provided the most favorable trade-off between fit and complexity according to BIC. Its AIC and SABIC were also lower than those of the three- and five-class models, although both indices were lowest for the six-class solution. Thus, adding more profiles did not consistently improve model quality across the fit criteria.

The bootstrap likelihood ratio test (BLRT) supported an improvement from three to four classes (p = 0.0099), whereas the five-class model did not significantly improve upon four classes (p = 0.9901). The four-class solution also achieved an entropy value of 0.832, indicating relatively clear classification. Although the six-class solution had higher entropy and lower AIC, it included several very small classes,

which reduced its appeal in terms of parsimony and interpretability. These findings collectively favor the four-class model over the five- and six-class alternatives.

Consistent with the model-selection logic discussed by Schel and Drechsel (2025), the number of profiles should not be determined by a single numerical index. The four-class solution was therefore prioritized as the working model because it had the lowest BIC and a significant BLRT improvement over three classes. Nevertheless, the three-class solution remains a plausible alternative because it has more balanced class sizes and slightly higher entropy. The four-profile interpretation that follows should consequently be viewed as the preferred current solution rather than an independently verified final classification.

4. Classification Quality of the Latent Profiles

Classification quality was examined to assess how confidently students were assigned to the profiles identified by the LPA model. Both overall entropy and mean posterior class-assignment probabilities were considered when evaluating the four-profile solution.

Table 8. Mean classification probabilities for the four-profile solution

Profile	Mean assignment probability
Profile 1	0.927
Profile 2	0.933
Profile 3	0.915
Profile 4	0.871

The average posterior assignment probabilities ranged from 0.871 to 0.933, exceeding the commonly used descriptive benchmark of 0.70 for every profile. Profile 2 had the highest mean probability (0.933), indicating particularly confident assignment among students classified in that group. Profile 4 had the lowest value (0.871), but it still showed relatively clear membership. Overall, the four-class solution distinguished its assigned members with comparatively limited classification uncertainty.

This interpretation is consistent with the model's entropy of 0.832. In the reporting approach of Schel and Drechsel (2025), entropy and posterior classification probabilities provide complementary evidence about profile separation. Both indicators suggest that the four-profile solution has satisfactory classification quality within the estimated model. Nevertheless, high assignment probabilities do not establish that the profiles will replicate in an independent

sample. Classification precision should therefore be distinguished from evidence of external validity or model stability.

5. Distribution of Students Across Independence Learning Profiles

Class membership frequencies were examined to describe how students were distributed across the four latent profiles. The resulting proportions indicate whether particular patterns of Independence Learning were common or relatively rare in the sample.

Table 9. Membership distribution of the four latent profiles

Profile	Students (*n*)	Percentage
Profile 1	56	20.22%
Profile 2	12	4.33%
Profile 3	143	51.62%
Profile 4	66	23.83%
Total	277	100.00%

Profile 3 accounted for the largest share of the sample, comprising 143 students (51.62%). Its predominance indicates that more than half of the respondents shared a broadly similar configuration of Independence Learning indicators. Profile 4 included 66 students (23.83%), followed by Profile 1 with 56 students (20.22%). These uneven proportions suggest that students' Independence Learning patterns were concentrated in certain configurations rather than being distributed uniformly across profiles.

Profile 2 was the smallest group, containing only 12 students (4.33%). This suggests that the characteristics represented by this profile were relatively uncommon among the participating students. A small class does not necessarily lack substantive meaning, especially when its indicator pattern is distinctive and classification probabilities are high. Schel and Drechsel (2025) likewise considered the interpretability of small profiles when evaluating their solution. Nonetheless, the small size of Profile 2 warrants caution regarding the stability and generalizability of its characteristics.

6. Patterns of the Six Dimensions Across the Four Profiles

The substantive meaning of the profiles was examined by comparing the original-scale means of learning goals, planning, monitoring, execution, evaluation, and reflection. These comparisons reveal both overall differences in Independence Learning and relative strengths or weaknesses within each group.

Table 10. Original-scale means of the six dimensions by profile

Dimension	Profile 1	Profile 2	Profile 3	Profile 4
Learning Goals	2.51	3.45	2.76	3.06
Planning	2.82	3.85	3.04	3.47
Monitoring	2.18	3.75	2.84	3.09
Execution	2.34	3.77	2.93	3.21
Evaluation	2.45	3.62	2.78	3.23
Reflection	2.73	3.17	2.78	3.05

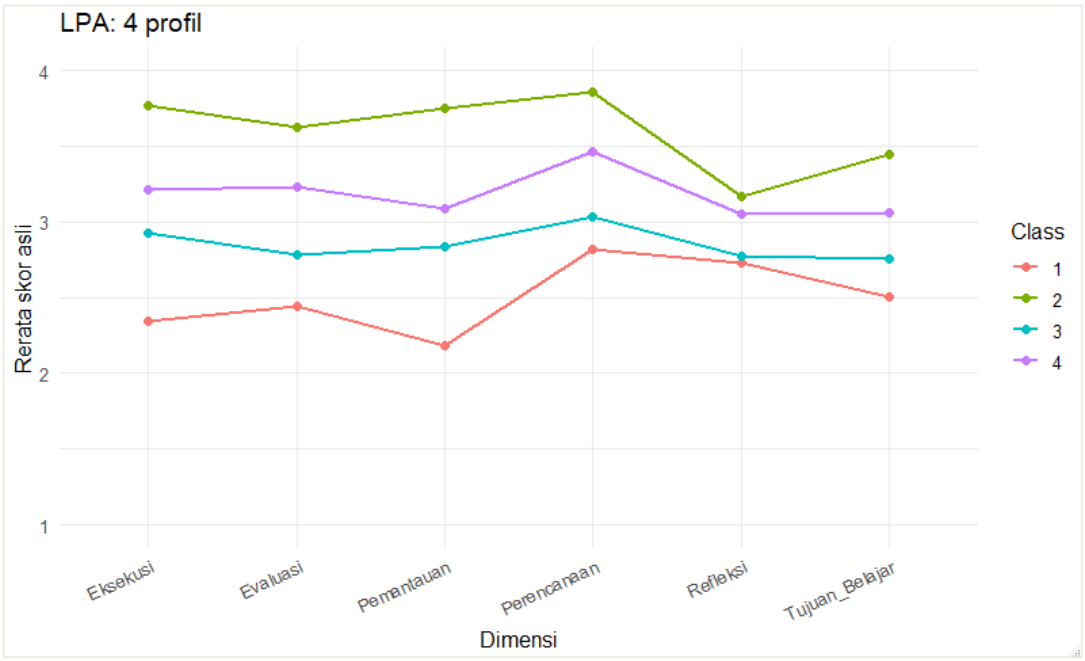


Figure 1. Latent Profiles of Independence Learning Among Senior High School Students Across Six Dimensions

Profile 2 had the highest mean on every dimension, followed by Profile 4, Profile 3, and Profile 1. This consistent ordering indicates that the profiles were differentiated primarily by their overall levels of Independence Learning rather than by sharply opposing patterns across dimensions. Students who scored relatively higher on one component generally also scored higher on the others. The heterogeneity identified in this sample therefore appears to be more strongly quantitative than qualitative.

Despite this overall ordering, each group exhibited some within-profile variation. Planning was the highest-scoring dimension in all four profiles, whereas monitoring and execution were particularly low in Profile 1 and reflection was comparatively less prominent in Profile 2. These differences suggest that stronger

overall Independence Learning does not necessarily imply equally developed capacities in every component. A person-centered interpretation should therefore consider both the general level of each profile and its relative pattern across the six dimensions.

7. Naming and Interpretation of the Four Profiles

The profiles were given descriptive names based on their relative positions and indicator configurations. These labels reflect differences within the present sample rather than externally validated cutoffs on the Independence Learning scale.

Profile 1: Low Independence Learning (*n* = 56; 20.22%)

Profile 1 had the lowest means across all six dimensions compared with the other groups. Monitoring was especially low (M = 2.18), followed by execution (M = 2.34) and evaluation (M = 2.45). Planning was comparatively strongest within this group (M = 2.82), followed by reflection (M = 2.73). This configuration points to a relative gap between preparing for learning and carrying out or supervising learning activities.

The comparatively weak monitoring and execution scores suggest that these students reported less developed capacities to maintain and oversee their learning activities. They may show some readiness to plan their work without demonstrating equally strong tendencies to implement and track those plans. From a self-regulated learning perspective, preparation alone does not guarantee effective action during the learning process. Profile 1 can therefore be interpreted as a group for whom support with implementation, progress monitoring, and evaluation may be especially relevant.

Profile 2: Very High Independence Learning (n = 12; 4.33%)

Profile 2 showed the highest means on all six Independence Learning dimensions. Its strongest components were planning (M = 3.85), execution (M = 3.77), and monitoring (M = 3.75). This combination indicates comparatively strong tendencies not only to organize learning but also to carry out and oversee learning activities. The profile therefore reflects particularly pronounced preparation- and action-related capacities.

Reflection, although higher than in all other profiles, was the lowest dimension within this group (M = 3.17). This suggests that reviewing and reconsidering learning experiences was relatively less pronounced than planning and implementation. Even students with very high overall Independence Learning may thus display differences

in the relative strength of their component skills. The small membership of this group (4.33%) further indicates that this exceptionally high-scoring configuration was uncommon in the sample.

Profile 3: Moderate Independence Learning (*n* = 143; 51.62%)

Profile 3 was the largest group, representing 143 students (51.62%). Its six means ranged from 2.76 to 3.04, placing the group between the lower- and higher-scoring profiles. Planning was its most pronounced dimension (M = 3.04), followed by execution (M = 2.93) and monitoring (M = 2.84). Learning goals (M = 2.76), evaluation (M = 2.78), and reflection (M = 2.78) were relatively less prominent.

The predominance of this group suggests that a moderate pattern of Independence Learning was the most common configuration in the sample. Students in this profile showed comparatively stronger preparation-related tendencies, while goal setting, evaluation, and reflection were less developed relative to planning. This can be understood as a pattern in which some components of independent learning are evident without consistently high scores across all dimensions. Given its large membership, this group may be particularly relevant when considering broadly targeted support for reflective and evaluative learning practices.

Profile 4: High Independence Learning (*n* = 66; 23.83%)

Profile 4 comprised 66 students (23.83%) and scored above Profiles 1 and 3 on every dimension while remaining below Profile 2. Planning was particularly prominent (M = 3.47), followed by evaluation (M = 3.23) and execution (M = 3.21). This combination suggests comparatively strong capacities to prepare, carry out, and assess learning activities. Overall, the group displayed a relatively broad pattern of high Independence Learning. Reflection (M = 3.05), learning goals (M = 3.06), and monitoring (M = 3.09) were the lowest dimensions within this profile. These values indicate that planning and evaluation were relatively more pronounced than reflection and ongoing monitoring. Students in this group therefore appear to demonstrate substantial self-management tendencies while still showing relative variation across components. Profile 4 can be interpreted as a high-learning-independence group with particular strengths in planning and carrying out learning tasks.

DISCUSSION

The Latent Profile Analysis (LPA) conducted among 277 senior high school students identified four distinct profiles, revealing heterogeneity in Independence Learning. Previous research has highlighted the importance of person-centered approaches for identifying meaningful differences in students' self-regulated learning characteristics (Broks et al., 2024; Shin & Son, 2024). In the present study, the profiles differed across six dimensions: learning goals, planning, monitoring, execution, evaluation, and reflection, indicating that Independence Learning cannot be adequately represented by an overall mean score alone. The largest profile comprised 143 students (51.6%), whereas the smallest included only 12 students (4.3%). These findings suggest that students exhibit different combinations of regulatory competencies, emphasizing the importance of understanding Independence Learning as a multidimensional construct.

Differences between profiles were particularly evident in students' ability to translate learning plans into sustained learning activities. Profile 1, comprising 56 students (20.2%), demonstrated relatively low monitoring (2.18) and execution (2.34) scores despite a higher planning score (2.82). Research on self-regulated learning has emphasized that students may differ in how effectively they implement regulatory strategies during learning activities (Aksela et al., 2025; Arvatz & Dori, 2025). Conversely, Profile 2, consisting of 12 students (4.3%), exhibited consistently high scores across all dimensions, particularly planning (3.85), execution (3.77), and monitoring (3.75). This contrast suggests that effective Independence Learning requires coordination between planning, monitoring, and implementation rather than relying solely on the ability to formulate learning goals.

Profile 3 represented the largest subgroup, comprising 143 students (51.6%), and displayed relatively balanced scores at a moderate level across the six dimensions. Meanwhile, Profile 4 included 66 students (23.8%) and demonstrated comparatively stronger Independence Learning, particularly in planning (3.47), evaluation (3.23), and execution (3.21). Previous studies using person-centered approaches have demonstrated the relevance of examining distinct learning-related characteristics and regulatory patterns among students (Xu et al., 2024; Zhou et al., 2025). The present findings similarly indicate that differences in Independence Learning reflect both the overall level of regulatory competence and the relative strengths of individual dimensions. Accordingly, students within different profiles may require different forms of instructional support, even when their overall levels of Independence Learning appear relatively similar.

From a learning-phase perspective, Profile 1 showed a decline from the pre-action phase (2.66) to the action phase (2.26), whereas Profile 2 maintained high scores across these phases (3.65 and 3.76, respectively). Recent research has emphasized the importance of integrating planning, monitoring, and evaluation strategies into learning activities to strengthen students' metacognitive regulation (Faza & Lestari, 2025; Kurniaty et al., 2025). This perspective suggests that strengthening Independence Learning should extend beyond goal setting and planning to include continuous monitoring, strategic implementation, and reflection throughout learning activities. Research involving secondary school students has also highlighted the potential contribution of feedback-related processes to self-regulated learning (Jin et al., 2025). Teachers may therefore consider differentiated instructional support, including progress-monitoring checklists, formative feedback, and structured reflection activities, particularly for students who experience difficulties during the action phase.

Overall, the findings demonstrate that Independence Learning among senior high school students is heterogeneous, with meaningful differences in regulatory competencies and the coordination of learning processes across phases. However, recent research on self-regulated learning in K–12 education underscores the need for further investigation into the stability of learner profiles and the effectiveness of differentiated instructional support (Toomla et al., 2026). Given the relatively small size of Profile 2 (4.3%), reliance on self-report data, and absence of academic achievement measures, future studies should examine profile stability in larger samples, compare alternative profile solutions, and investigate associations between profile membership and academic outcomes.

CONCLUSION

This study identified four latent profiles of Independence Learning among 277 senior high school students, revealing heterogeneity in their abilities to establish learning goals, plan, monitor, execute, evaluate, and reflect on learning activities. The four profiles demonstrated distinct characteristics, ranging from relatively low learning regulation to moderate levels and consistently stronger Independence Learning across multiple dimensions. The most notable differences emerged in monitoring and execution, suggesting that effective learning planning does not necessarily translate into the successful implementation of learning strategies. These findings highlight the importance of differentiated instructional approaches that strengthen progress monitoring, strategy implementation, and reflection according to students' profile characteristics. Future research should examine the stability of these profiles in larger and more diverse samples and investigate their relationships with students' academic achievement.

REFERENCES

Aksela, O., Lämsä, J., & Järvelä, S. (2025). Secondary School Students' Enacted Self-Regulated Learning Strategies in a Computer-Based Writing Task–Insights from Digital Trace Data and Interviews. *Technology, Knowledge and Learning*, *30*, 1727–1756. https://doi.org/10.1007/s10758-024-09789-4

Arvatz, A., & Dori, Y. J. (2025). Science and Mathematics High School Students' Perceptions of Self-Regulated Learning. *International Journal of Science and Mathematics Education*, *23*, 1467–1492. https://doi.org/10.1007/s10763-024-10516-9

Broks, V. M. A., Dijk, S. W., Van den Broek, W. W., Stegers-Jager, K. M., & Woltman, A. M. (2024). Self-regulated learning profiles including test anxiety linked to stress and performance: A latent profile analysis based across multiple cohorts. *Medical Education*, *58*(5), 544–555. https://doi.org/10.1111/medu.15283

Dörrenbächer Ulrich, L., & Bregulla, M. (2024). The Relationship Between Self-Regulated Learning and Executive Functions—a Systematic Review. *Educational Psychology Review*, *36*(3), 95. https://doi.org/10.1007/s10648-024-09932-8

Fahrni, D., Iten, G., Prasse, D., & Hascher, T. (2025). Teachers' practices in the use of digital technology to promote students' self-regulated learning and metacognition: A systematic review. *Teaching and Teacher Education*, *165*, 105150. https://doi.org/10.1016/j.tate.2025.105150

Faza, A., & Lestari, I. A. (2025). Self-Regulated Learning in the Digital Age: A Systematic Review of Strategies, Technologies, Benefits, and Challenges. *International Review of Research in Open and Distributed Learning*, *26*(2), 23–58. https://doi.org/10.19173/irrodl.v26i2.8119

Irsalina, F. R., Aviyanti, L., & Rahayani, Y. (2025). Self-regulated learning in physics: A comprehensive study of high school students through the lens of the Rasch Model. *Momentum: Physics Education Journal*, *9*(2), 200–216. https://doi.org/10.21067/mpej.v9i2.11393

Jin, F. J.-Y., Nath, D., Guan, R., Li, T., Li, X., Mello, R. F., Rodrigues, L., Pereira Junior, C., Abuzayyad-Nuseibeh, H., Raković, M., Martinez-Maldonado, R., Gašević, D., & Tsai, Y.-S. (2025). Analytics of Self-Regulated Learning in Learning Analytics Feedback Processes: Associations With Feedback Literacy in Secondary Education. *Journal of Computer Assisted Learning*, *41*(4), e70076. https://doi.org/10.1111/jcal.70076

Keumala, M., Putri, Z., Ismail, N. M., Faizah, C., & Zuhra, C. M. (2026). Exploring Learner Autonomy in AI-Assisted EFL Learning: A Comparative Classroom Observation of ChatGPT Use in Indonesian Senior High Schools. *New Language Dimensions*, *7*(1), 83–98. https://doi.org/10.26740/nld.v7n1.p83-98

Kurniaty, D., Muslim, M., & Novia, H. (2025). Thinking About Thinking in Physics: A Systematic Review on Metacognitive Approaches for Secondary Students. *Jurnal Pendidikan MIPA*, *26*(4), 2246–2266.

https://doi.org/10.23960/jpmipa.v26i4.pp2246-2266

Pedrosa, D., Lins, A., Dominguez, C., Silva, H., & Morais, E. (2026). Pedagogical Interventions That Support Self-Regulated Learning in Secondary School Students: A Systematic Literature Review. *Education Sciences*, *16*(10), 1638. https://doi.org/10.3390/educsci16101638

Shin, E. J., & Son, W. S. (2024). Latent Transition Analysis of Self-regulated Learning during the Transition from Middle to High School Grade Levels and Influential Factors. *Journal of Curriculum and Evaluation*, *27*(2), 299–322. https://doi.org/10.29221/jce.2024.27.2.299

Toomla, K., Hooshyar, D., Kikas, E., Malva, L., Malleus-Kotšegarov, E., & Aus, K. (2026). Tracing and supporting self-regulated learning in K-12 digital learning: A systematic review of the last three decades (1990-2024). *Educational Research Review*, *51*, 100782. https://doi.org/10.1016/j.edurev.2026.100782

Torres, A. C., & Duarte, M. (2024). Self-regulated learning in secondary school: students' self-feedback in a peer observation programme. *Studies in Educational Evaluation*, *83*, 101407. https://doi.org/10.1016/j.stueduc.2024.101407

Xu, J., Zhang, S., & Chen, H. (2024). Relationship between types of emotion regulation and reflective learning: Based on latent profile analysis. *Learning and Motivation*, *88*, 102041. https://doi.org/10.1016/j.lmot.2024.102041

Zhao, Y., Li, Y., Ma, S., Xu, Z., & Zhang, B. (2025). A meta-analysis of the correlation between self-regulated learning strategies and academic performance in online and blended learning environments. *Computers & Education*, *230*, 105279. https://doi.org/10.1016/j.compedu.2025.105279

Zhou, T., Zhou, X., & Wang, B. (2025). Latent profiles of learning engagement and anxiety in high school students: the mediating role of academic self-efficacy. *BMC Psychology*, *13*(1), 784. https://doi.org/10.1186/s40359-025-03114-z