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Motivation and learning strategies among students in upper secondary education: grade level differences and academic outcomes

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This study examined grade-level differences in motivation and learning strategies and their relations to academic achievement (GPA) from a self-regulated learning (SRL) perspective. Participants were 401 Norwegian upper secondary/senior high school students (mean age = 17.1) who completed a 27-item short-form MSLQ assessing intrinsic and extrinsic goal orientation, self-efficacy, and cognitive, metacognitive, and resource management strategies. Confirmatory factor analysis supported a nine-factor model. Configure, metric, and scalar invariance held across grades 1–3, enabling mean comparisons. ANOVAs indicated significant grade-level declines in intrinsic goals, organization, and effort management, with the largest differences between first- and third-year students. All motivation and strategy variables correlated positively with GPA, with self-efficacy showing the strongest association ($r = 0.51$). Hierarchical regression revealed that motivation explained 33% of GPA variance, with cognitive strategies adding 4% and metacognitive/resource strategies adding 5%, while self-efficacy remained as the strongest predictor ($\beta = 0.38$). Findings underscore the robustness of the abbreviated MSLQ, highlight declines in intrinsic motivation and effort management across grades, and emphasize self-efficacy, metacognitive regulation, and effort management as key targets for instructional support. Limitations include a single-school sample and cross sectional design.

KEYWORDS

self-regulated learning, motivation, learning strategies, self-efficacy, academic achievement

Introduction

According to a self-regulated learning (SRL) perspective, motivation and learning strategies play a critical role in shaping students' learning outcomes (Theobald, 2021). Key motivational factors include goal orientation and expectancy, particularly in the form of self-efficacy. Learning strategies are typically described as cognitive and metacognitive strategies, in addition to resource management strategies.

Motivation and learning strategies are commonly assessed through self-reported surveys, such as the Motivated Strategies for Learning Questionnaire (MSLQ). This survey captures students' perspectives on their study habits and the ways in which their efforts are driven by motivation. However, validation of shorter versions of the MSLQ remains an ongoing issue. Furthermore, students' motivation and learning strategies may differ according to grade levels, and they are differentially related to academic achievement.

Hence, this study will investigate the factor structure of a short version of the MSLQ. Furthermore, it will compare mean levels of motivation and learning strategies according to grade level throughout the upper secondary (senior high) school years. Finally, the present study investigates how motivation and learning strategies are related to the students' academic achievement in terms of grades.

Motivation and learning strategies

Both motivation and learning strategies are important for students' self-regulated learning and performance. Motivation energizes students toward academic success (Schunk and DiBenedetto, 2020). Within SRL, motivation is often conceptualized as goal orientation (intrinsic and extrinsic) and self-efficacy (Panadero, 2022). Learning strategies support effective information processing (Broadbent and Fuller-Tyszkiewicz, 2022). By integrating self-regulated learning strategies, students can enhance their learning efficiency and increase the likelihood of achieving their goals. Conversely, goals and self-efficacy have a positive influence on learning strategies. Hence, there is a reciprocal relationship between motivation and learning strategies (Schunk and DiBenedetto, 2020).

The present study focuses on the three motivational constructs of intrinsic goal orientation, extrinsic goal orientation, and self-efficacy, as well as cognitive, metacognitive, and resource management strategies. Motivation energizes students toward academic success (Pintrich and De Groot, 1990; Schunk and DiBenedetto, 2020), and is commonly conceptualized within self-regulated learning (SRL) as goal orientation and self-efficacy (Panadero, 2022). Intrinsic and extrinsic goal orientations capture different reasons for engaging in academic tasks: intrinsic goals reflect learning for understanding and personal growth, while extrinsic goals are driven by external rewards such as grades or recognition (Vansteenkiste et al., 2020). Including both provides a comprehensive view of how different motivational types relate to strategic learning behavior. Self-efficacy, defined as students' beliefs in their ability to succeed in academic tasks (Bandura, 1997), enhances performance by increasing effort, persistence, goal setting, and the use of effective learning strategies (Schunk and DiBenedetto, 2020).

Learning strategies support effective information processing (Panadero, 2017; Broadbent and Fuller-Tyszkiewicz, 2022), and are typically classified as cognitive, metacognitive, and resource management strategies (Zimmerman, 2002). Cognitive strategies include rehearsal (repetition), elaboration (linking new information to prior knowledge), and organization (structuring information) (Dunlosky et al., 2013). Metacognitive regulation involves monitoring learning progress and comprehension, while resource management strategies, such as effort regulation and peer learning, help optimize the learning environment. Effort regulation entails maintaining motivation and persistence through challenges, and peer learning involves collaborating with others to enhance understanding. These SRL variables were selected because they represent central dimensions of SRL with strong theoretical and empirical relevance in educational psychology (Wang et al., 2023).

Taken together, cognitive strategies facilitate the encoding and integration of new information, metacognitive regulation enables planning and monitoring of comprehension, and resource management strategies support sustained effort and collaborative

engagement. These variables reflect how students process, monitor, and manage their learning. They provide a multidimensional understanding of how motivation and strategies interact to influence academic achievement.

Grade level differences in motivation and learning strategies

Research has shown grade level differences in motivation and learning strategies among students. Younger students display strong intrinsic motivation, driven by curiosity and a view of learning as rewarding, but this often declines through school years (Scherrer and Preckel, 2019). Adolescence brings a notable drop in intrinsic motivation due to social comparisons, academic pressure, and a shift to extrinsic motivators like grades (Gnams and Hanfstingl, 2016). Standardized testing and competitive environments can reduce learning enjoyment, especially for students with low self-efficacy (Tang et al., 2021). For example, research has shown that intrinsic motivation decreases from elementary through high school, with the largest drops in adolescence (Gottfried et al., 2001).

Lower levels of intrinsic motivation among secondary school students align with lower levels of mastery (intrinsic) goals and higher levels of performance (extrinsic) goals (Mouratidis et al., 2018). Accordingly, intrinsic goals often correlate less with grades than extrinsic goals among upper secondary school students, especially when the assessments are focused on grades (Hulleman et al., 2010). Students with high self-efficacy often pursue intrinsic goals and persist despite challenges, though grade emphasis can weaken self-efficacy for students who struggle to achieve (Senko, 2019).

While students' cognitive development during secondary school has been investigated, there appears to be less research on grade level differences in particular learning strategies. However, learning strategies are crucial for lifelong learning (Dignath and Büttner, 2018). In upper secondary school (ages 15–18), students develop cognitive and metacognitive skills to meet academic demands (Demetriou and Bakracevic, 2009). Metacognitive skills improve, with students using summarizing an analogy to connect knowledge (Veenman, 2011). However, given that students in upper secondary school years may experience lower levels of motivation, some learning strategies may also decrease in strength.

Academic achievement

Self-regulated learning in terms of motivation and learning strategies have been consistently linked to academic achievement (Zimmerman, 2002). Students who are motivated to learn and who employ effective learning strategies tend to engage more deeply with academic material, persist through challenges, and ultimately perform better.

As regards motivation, intrinsic goals correlate with grades, though their impact varies by task or prior achievement (Vrugt et al., 2002). They work best when assessments reward understanding and align with interests. Extrinsic goals, emphasizing grades, predict achievement more directly, aligning with memorization and grade-focused systems (Mouratidis et al., 2018). Balancing intrinsic and extrinsic goals optimizes outcomes, with self-efficacy enhancing both (Luo et al., 2011).

Intrinsic goals is related to engagement and conceptual understanding, while extrinsic incentives like grades boost graded performance but may undermine intrinsic motivation (Ryan and Deci, 2020; Cerasoli et al., 2014). However, indirect incentives, like feedback, support intrinsic goals.

In addition to intrinsic and extrinsic goals, self-efficacy is also constantly related to academic achievement (Honicke and Broadbent, 2016). Students with high self-efficacy are more likely to set challenging goals, engage in effective learning strategies, and persevere through difficulties, leading to better academic performance. They also tend to have less anxiety and stronger resilience, which further supports success in academic tasks (Zimmerman and Schunk, 2001).

Measurement of SRL

A frequently utilized instrument to measure students' motivation and learning strategies is The Motivated Strategies for Learning Questionnaire (MSLQ). The MSLQ has provided reliable and valid knowledge in numerous studies (Hilpert et al., 2013). For instance, the instrument has been widely used to explore the relationship between motivation, learning strategies, and academic achievement (Pintrich and García, 1994). As a widely utilized tool for research on self-regulation, the MSLQ is valuable for researchers and educators aiming to understand and enhance students' learning processes (Duncan and McKeachie, 2005).

Studies using the MSLQ show that self-efficacy, extrinsic goals, organization, and effort regulation predict achievement, extrinsic goals can have negative effects (Keklik and Keklik, 2013; Öztürk et al., 2007; Üredi and Üredi, 2005). Pintrich et al. (1993) found positive correlations between grades and self-efficacy, intrinsic goals, rehearsal, elaboration, and effort regulation (Rotgans and Schmidt (2010). Noted effort regulation and self-efficacy as key predictors. A meta-analysis by Credé and Phillips (2011) showed that effort regulation was the strongest predictor of grades, while help-seeking was the weakest. Self-efficacy often outweighs cognitive or metacognitive strategies as predictor of achievement, but strategies like organization and effort regulation also correlate with higher grades (Ortega-Torres et al., 2020; Keklik and Keklik, 2013). Taken together, research has shown that factors describing motivation and learning strategies as measured by means of MSLQ is consistently related to academic achievement.

Whereas the MSLQ has provided a valuable contribution to measure SRL in terms of motivation and learning strategies, there may be some challenges employing this instrument. It is relatively lengthy and consists of many factors. Hence, there has been efforts to produce shorter versions of this instrument by reducing number of items per factor (e.g., Wang et al., 2023) and/or to select specific factors. The present study will employ a combination of these approaches to facilitate data collection (Ziegler et al., 2014) and produce a study based upon a selection of relevant factors, as described previously in the introduction section.

Problems and hypotheses

The present study addresses the following research questions:

- 1 Will the present study produce a valid measurement model of selected factors describing motivation and learning strategies?

- 2 Are there mean level differences in motivation and learning strategies between students at different grade levels of upper secondary education?
- 3 What are the relations between students' motivation, learning strategies and academic achievement in terms of grades?

Based on the above-mentioned theoretical assumption and previous research findings, the following hypotheses are put forward:

- 1 The measurement mode will support factors describing motivation (intrinsic goals, extrinsic goals and self-efficacy) and learning strategies (rehearsal, elaboration, organization, metacognitive self-regulation, effort regulation and peer learning).
- 2 Students in the final year of upper secondary education will display a lower mean level of intrinsic goals than students in the first year.
- 3 There will be significant inter correlations between motivation and learning strategies, and these variables will be positively correlated with academic achievement in terms of grades.

Methods

Participants

The participants included a total of 401 Norwegian students, comprising 140 boys and 261 girls (mean age 17.1 years). A total of 570 students were enrolled at the participating school at the time of data collection. Teachers were invited to distribute the survey to all students. However, not all teachers distributed the survey, which resulted in partial participation. Consequently, data was collected from 402 students, representing approximately 70.5% of the total student population. The sample was distributed across three upper secondary grade levels (grade 1: 138 students; grade 2: 125 students; grade 3: 138 students). The survey was administered digitally during assigned class times, and every individual student had to respond to each item (no missing data). The students' responses were automatically linked to their identities (names), allowing for the collection of academic achievement data (grades) from the school register. Students were informed that their names were recorded solely for the purpose of retrieving grade data on one occasion, after which all data would be anonymized. They were also assured that participation was voluntary and that they could withdraw at any time.

Given the processing of personal data, the study was registered in the University of Bergen's System for Risk and Compliance for research projects involving personal data, in accordance with institutional guidelines. Since all participants were over 16 years old, Norwegian law permits them to consent independently, without parental/guardian approval.

Measures

The survey comprised items and factors from a short version of the MSLQ which has previously been validated in research by Wang et al. (2023). The MSLQ was first described by Pintrich (1991) in a manual and subsequently validated (Pintrich et al., 1993). This instrument

comprises 81 items divided into motivation (six factors) and learning strategies (nine factors). In a short version of the MSLQ by Wang et al. (2023) each factor from the original MSLQ (six factors for motivation and nine factors for learning strategies) was reduced to three items whilst keeping all the factors, thus reducing total number of items from 81 to 45 items. The present study utilized a selection of nine out of 15 factors from the Wang et al. (2023) study, totaling 27 items.

The MSLQ was originally designed to measure self-regulated learning (SRL) for specific subjects, based on the assumption that students employ different strategies in different subjects. However, research has shown that this instrument can also be used to measure general motivation and learning strategies across various subjects (Bråten and Strømso, 2005; Muwonge et al., 2020; Rotgans and Schmidt, 2010). Hence, Items were formulated to reflect general motivation with no reference to specific courses in the present study. The current Norwegian version of the scale was translated through a rigorous translation-back translation process, ensuring linguistic and conceptual equivalence in accordance with established guidelines (Harkness et al., 2010; ITC, 2017). The selected factors and example items measuring motivation and learning strategies are described below.

Motivation

Motivation was measured in terms of intrinsic goals (e.g., “I prefer course material that really challenges me so I can learn new things”), extrinsic goals (e.g., “Getting a good grade is the most satisfying thing for me right now”) and self-efficacy (e.g., “I believe I will receive excellent grades”) developed on basis of the scale by Wang et al. (2023). The participants responded on a scale from 1 (“strongly disagree”) to 5 (“strongly agree”).

Learning strategies

Items measuring cognitive strategies, metacognitive strategies and resource management were utilized (Wang et al., 2023). The cognitive strategies were rehearsal (e.g., “I make lists of important terms and memorize the lists.”), elaboration (e.g., “I try to apply ideas from school subjects in other class activities such as lecture and discussion.”) and organization (e.g., “I make simple charts, diagrams, or tables to help me organize course material.”). The metacognitive strategies were metacognitive self-regulation (e.g., “If I get confused, I make sure I sort it out afterwards.”) Resource management was measured in terms of effort regulation (e.g., “I work hard to do well at school even if I do not like what we are doing.”) and peer learning (e.g., “When studying, I often try to explain the material to a classmate or a friend.”). The participants responded on a scale from 1 (“strongly disagree”) to 5 (“strongly agree”).

Academic achievement

Final assessment grades for all school subjects were collected for each student from the student register. These grades were summed and divided by the total number of subjects to calculate a grade point average (GPA) for each student, which served as the measure of academic achievement.

Data analysis

The structural equation model (SEM) program IBM SPSS AMOS 29.0 (IBM Corp, 2022) was utilized to perform confirmatory factor

analysis (CFA) on the motivation and learning strategies items. The CFA was evaluated by means of the comparative fit index (CFI), which should be above 0.90 (Hu and Bentler, 1999) and the root mean square error of approximation (RMSEA) should ideally be below 0.05 or 0.06. Finally, the chi square/degrees of freedom (χ^2/df) ratio, should ideally be less than two (Byrne, 2010). The convergent validity (Messick, 1995) of the motivation and learning strategies variables were investigated by correlating them to academic achievement. ANOVA was utilized to investigate grade level differences.

Results

Measurement model and descriptive

To produce a measurement model for motivation and learning strategies variables, a confirmatory factor analysis was performed. This analysis produced good model fit ($\chi^2 = 532.370$, $\text{df} = 285$, $p < 0.000$, $\chi^2/\text{df} = 1.868$, CFI = 0.925, RMSEA = 0.047, CI (90) = 0.041–0.053). Item loadings (Table 1) were between 0.51 and 0.82. Factor loadings above 0.50 are considered satisfactory (Hair et al., 2019).

Descriptive statistics (Table 1) were analyzed to investigate data distribution on basis of the measurement model. Skewness and kurtosis values showed that the data were normally distributed and could be utilized for further analyses.

Invariance tests

Invariance tests were performed to investigate the statistical integrity of the model across the three grade level samples (first, second and third year upper secondary school). Test of configure invariance showed good model fit [$\chi^2 = 589.230$, $\text{df} = 316$, $p < 0.000$, $\chi^2/\text{df} = 1.370$, CFI = 0.917, RMSEA = 0.031, CI (90) = 0.026–0.035]. Furthermore, a test of metric invariance also showed good model fit [$\chi^2 = 647.758$, $\text{df} = 362$, $p < 0.000$, $\chi^2/\text{df} = 1.360$, CFI = 0.911, RMSEA = 0.031, CI (90) = 0.027–0.031]. The difference between configure and metric invariance was not significant ($\Delta\chi^2 = 58.528$, $\Delta\text{df} = 46$, $p < 0.11$, $\Delta\text{CFI} = 0.006$, $\Delta\text{RMSEA} = 0.000$). Finally, a scalar invariance model produced good model fit [$\chi^2 = 679.045$, $\text{df} = 383$, $p < 0.000$, $\chi^2/\text{df} = 1.368$, CFI = 0.904, RMSEA = 0.032, CI (90) = 0.028–0.036]. The difference between metric and scalar invariance was not significant ($\Delta\chi^2 = 31.287$, $\Delta\text{df} = 21$, $p < 0.069$, $\Delta\text{CFI} = 0.007$, $\Delta\text{RMSEA} = 0.001$) indicating support for scalar invariance.

Taken together, the CFA analysis supported a viable factor structure. Invariance testing supported configure, metric and scalar invariance. Hence, group comparison of mean levels may be compared.

Comparison between grade levels

An ANOVA was performed to compare grade level mean values. The results (Table 2) showed that there were significant grade level effects for intrinsic goals, extrinsic goals, organizing strategies and effort management.

TABLE 1 Confirmatory factor analysis (item loadings) and descriptive statistics [mean (range 1–5), standard deviation, skewness and kurtosis].

Factors	Item loadings	Mean	Sd	Skew.	Kurt.
Intrinsic	0.54	3.68	0.62	−0.43	0.54
	0.52				
	0.61				
Extrinsic	0.79	3.74	0.76	−0.30	0.02
	0.78				
	0.51				
Self-efficacy	0.75	3.54	0.75	−0.39	0.55
	0.70				
	0.75				
Repetition	0.82	3.47	0.78	−0.62	0.84
	0.78				
	0.53				
Elaboration	0.71	3.70	0.71	−0.23	0.12
	,73				
	0.65				
Organizing	0.56	3.22	0.76	−0.17	0.11
	0.76				
	0.54				
Metacognitive reg	0.59	3.67	0.64	−0.21	0.45
	0.55				
	0.69				
Effort management	0.75	3.45	0.80	−0.14	−0.03
	0.79				
	0.77				
Peer learning	0.58	3.76	0.75	−0.37	0.21
	0.65				
	0.80				

Effect sizes (Cohens d) showed that the largest effects were for Intrinsic motivation ($d = 0.52$), organization ($d = 0.40$) and effort management ($d = 0.64$). These variables were meaningfully differences by grade level. The other variables had small to medium effect sizes.

To further explore the variables showing significant grade level differences in the ANOVA (intrinsic, organization and effort management), a Tukey HSD multiple comparison test (Table 3) was performed.

The strongest contrasts were between first and third grade level [Intrinsic motivation: 1–3 ($d = 0.40$), organization: 1–3 ($d = 0.32$) and effort management: 1–3 ($d = 0.50$)]. First-year students tend to show higher motivation and strategy use, especially for effort management and intrinsic motivation.

Correlations

A bi-variate correlation analysis (Table 4) was performed to investigate the relationship between the abovementioned variables

and academic achievement in terms of grades. Analysis of 95% confidence intervals showed that they were consistently positive and relatively narrow, ranging from approximately 0.06–0.62, indicating precise and reliable estimates of the relationships among variables. The limited width of the intervals suggests the sample size was sufficiently large with stable correlations. Finally, the absence of zero within any interval confirms that the observed associations are unlikely to be due to sampling error.

There were positive inter correlations between all motivation and learning strategies variables. All these correlations were significant at the 1% level ($p < 0.01$), except the correlation between self-efficacy and repetition, which was significant at the 5% level ($p < 0.030$).

Specifically, intrinsic goals were positively associated with all learning strategies ($r = 0.25$ – 0.49 , $p < 0.001$), and extrinsic goals showed weaker but significant positive correlations ($r = 0.22$ – 0.40 , $p < 0.001$). Mastery was positively related to all strategies, with the strongest associations for elaboration ($r = 0.40$) and metacognitive strategies ($r = 0.43$, $p < 0.001$). Repetition, elaboration, and organization were positively interrelated, and also correlated with metacognitive strategies, effort regulation, and peer learning ($r = 0.22$ – 0.55 , $p < 0.001$). To control for Type I error across the 36 pairwise correlations, a Holm–Bonferroni correction was applied. The familywise error rate (FWER) was maintained at $\alpha = 0.05$, corresponding to a Bonferroni-adjusted α of 0.00139. All correlations remained significant after correction, except for the association between mastery and repetition ($r = 0.11$, $p = 0.030$). Overall, these findings indicate that students with higher goal orientations and perceived mastery engage more frequently in self-regulated learning behaviors.

Academic achievement (grades) was significantly positively correlated with all the motivation and learning strategies variables ($p < 0.01$). Effect sizes (Cohens d) were calculated. The strongest correlation/effect size was between academic achievement and self-efficacy ($r = 0.51$, $p < 0.01$, $d = 0.120$). Other correlations/effect sizes regarding academic achievement were medium to large intrinsic goal ($r = 0.33$, $d = 0.71$), medium (extrinsic goal $r = 0.31$, $d = 0.67$; metacognitive regulation $r = 0.27$, $d = 0.57$; effort management $r = 0.27$, $d = 0.57$; peer learning $r = 0.25$, $d = 0.52$) and small (repetition $r = 0.18$, $d = 0.37$; elaboration $r = 0.22$, $d = 0.45$; organization $r = 0.16$, $d = 0.33$).

A hierarchical regression analysis was conducted to predict students' grades. In Step 1, motivational factors (intrinsic, extrinsic, and self-efficacy) explained 33% of the variance in grades ($R^2 = 0.33$, $p < 0.001$). In Step 2, the addition of cognitive strategies (repetition, elaboration, organizing) produced a small but significant increase in explained variance ($\Delta R^2 = 0.04$, $p < 0.05$). In Step 3, metacognitive regulation, effort management, and peer learning contributed an additional 5% ($\Delta R^2 = 0.05$, $p < 0.05$). Across all models, self-efficacy emerged as the strongest predictor of grades ($\beta = 0.38$, $p < 0.001$), followed by metacognitive regulation and effort management in the final model.

Discussion

This study aimed at exploring how students perceive their own motivation and learning strategies as measured by means of an adapted version of the MSLQ. It was also an aim to compare grade

TABLE 2 Variance analysis (ANOVA) by grade level and effect sized (Cohens *d*).

Variables	Grade level					ANOVA			
	1	2	3	SSq.	df	Msq.	F	Sig.	<i>d</i>
Intrinsic	3.81	3.64	3.56	4.43	2	2.22	5.90	0.003	0.52
Extrinsic	3.86	3.68	3.65	3.45	2	1.73	3.03	0.051	0.36
Self-efficacy	3.61	3.55	3.45	1.77	2	0.88	1.59	0.206	0.28
Repetition	3.59	3.43	3.39	2.93	2	1.47	2.43	0.089	0.34
Elaboration	3.76	3.71	3.62	1.29	2	1.64	1.28	0.278	0.24
Organization	3.35	3.17	3.11	4.16	2	2.08	3.66	0.027	0.40
Metacognitive reg.	3.74	3.64	3.61	1.27	2	0.64	1.57	0.210	0.26
Effort management	3.68	3.38	3.29	11.40	2	5.70	9.33	0.001	0.64
Peer learning	3.85	3.78	3.63	3.13	2	1.57	2.82	0.061	0.36

TABLE 3 Tukey HSD multiple comparisons of grade level mean differences and effect sized (Cohens *d*).

Variable	Grade	M. diff.	S. err.	Sig.	<i>d</i>
Intrinsic	1–2	0.25	0.08	0.003	0.27
	1–3	0.18	0.07	0.042	0.40
	2–3	−0.07	0.08	0.603	0.13
Organization	1–2	0.24	0.09	0.027	0.24
	1–3	0.17	0.09	0.128	0.32
	2–3	−0.07	0.09	0.759	0.08
Effort management	1–2	0.30	0.10	0.006	0.38
	1–3	0.39	0.09	0.001	0.50
	2–3	0.08	0.10	0.641	0.12

level differences in motivation and learning strategies, and to investigate how these variables are related to the students' academic achievement in terms of grades.

Measurement of variables

The confirmatory factor analysis (CFA) supported the hypothesized measurement model for the motivation and learning strategies constructs, demonstrating satisfactory model fit across all indices, in accordance with the first hypothesis. Factor loadings suggest that the observed indicators were reliable and valid representations of their respective latent constructs. The measurement invariance analyses further supported the robustness of the factor structure across the three grade levels (first, second, and third year of upper secondary school).

Selection of specific factors from the MSLQ to shorten the survey and measure variables of particular interest is in accordance with previous research (Pintrich and De Groot, 1990). A short questionnaire allows researchers to simultaneously measure more constructs, saves response time, maximizes the utility of questionnaire space, and has fewer logistical issues (Ziegler et al., 2014). It may also alleviate response fatigue and boredom, reducing missing data produced by careless answers (Credé and Phillips, 2011).

Taken together, analysis of the MSLQ variables provided strong evidence for the validity and stability of the measurement model. The results suggest that the motivation and learning strategy variables are consistently represented across grade levels, reinforcing the theoretical coherence of the model and its applicability in studies of self-regulated learning among upper secondary students.

Comparison of grade levels

Due to the valid measurement model described above, mean-level comparisons across grade levels were statistically valid and meaningful. The findings indicate significant grade-level differences in intrinsic goal orientation and effort management, with first-year upper secondary students reporting higher levels compared to their second- and third-year counterparts. Hence, the second hypothesis was supported. These results align with prior research suggesting that younger or less experienced students may exhibit stronger motivational drive due to the novelty of the secondary school environment and fewer accumulated academic setbacks (Gutman and Eccles, 2007). The transition to secondary education often brings heightened goal-directed behavior and effort, which may weaken as student's progress through subsequent years and encounter increasing academic demands or social pressures (Wigfield et al., 2006).

No significant grade-level differences were observed in self-efficacy, suggesting that students across the first 3 years of secondary education maintain comparable levels of confidence in their academic abilities. This finding contrasts with some studies that report a decline in self-efficacy as students face more challenging curricula in higher grades (Schunk and Pajares, 2002). The stability in self-efficacy in the present study may reflect effective teaching practices or supportive school environments that reinforce students' confidence across grade levels.

Regarding learning strategies, first-year students reported significantly higher levels of organization compared to second- and third-year students, also supporting the second hypothesis. This finding is consistent with research indicating that younger students may initially adopt structured strategies to cope with the demands of secondary education (Zimmerman and Martinez-Pons, 1990). The decline in organizational strategies among older students could be attributed to increased familiarity with academic routines, leading

TABLE 4 Correlations between variables.

Variables	1	2	3	4	5	6	7	8	9	10
1. Intrinsic	–									
2. Extrinsic	0.41	–								
3. Self-efficacy	0.49	0.38	–							
4. Repetition	0.25	0.28	11*	–						
5. Elaboration	0.48	0.28	0.40	0.31	–					
6. Organizing	0.25	0.27	0.18	0.49	0.36	–				
7. Metacog. reg.	0.41	0.36	0.43	0.32	0.55	0.35	–			
8. Effort man.	0.42	0.23	0.39	0.35	0.38	0.28	0.39	–		
9. Peer learning	0.29	0.22	0.28	0.22	0.31	0.23	0.30	0.29	–	
10. Grades	0.33	0.31	0.51	0.18	0.22	0.16	0.27	0.27	0.25	–

All correlations were significant at the 1% level ($p < 0.01$) except *($p < 0.05$).

to less reliance on structured approaches. Competing priorities such as social activities may also detract from strategic learning behaviors. The absence of grade-level differences in other learning strategies suggests that strategies such as elaboration or metacognitive regulation may be less sensitive to grade-level progression or require explicit instruction to develop (Pintrich and De Groot, 1990).

Correlations

Positive inter correlations among motivational and learning strategy variables supported the third hypothesis, indicating that motives and strategies function in a mutually reinforcing manner within SRL. Students with stronger intrinsic and mastery goals tended to use deep learning strategies such as elaboration, organization, and metacognitive regulation, consistent with findings that mastery-oriented learners favor meaning-focused approaches that enhance conceptual understanding and long-term retention (Pintrich, 2000).

Both intrinsic and extrinsic goals were positively related to learning strategies, suggesting that while external incentives can encourage engagement, internalized motives are more strongly linked to effective self-regulated learning. This aligns with self-determination theory, which posits that autonomous motivation better supports sustained learning and achievement than controlled motivation (Deci et al., 1999).

Strong interrelations among strategies such as repetition, elaboration, organization, and metacognition highlight the integrated nature of cognitive and metacognitive processes in SRL. Strategic learners not only manage their cognition but also regulate effort and seek social resources, as reflected in positive links with effort regulation and peer learning.

Overall, these findings underscore the dynamic interplay between motivation, learning strategies, and achievement. Students with higher self-efficacy, strong goal orientations, and intrinsic motivation engage more deeply in SRL behaviors, supporting higher performance. Self-efficacy emerged as the strongest predictor of achievement, emphasizing its role in persistence, effort regulation, and effective learning (Bandura, 1997; Zimmerman, 2002).

Intrinsic goals foster understanding, persistence, and resilience (Dubayová and Hačková, 2023), particularly in supportive environments that encourage intellectual risk-taking (Niu et al., 2022).

In contrast, extrinsic goals driven by rewards like grades or recognition relate to achievement mainly in competitive contexts (Harackiewicz et al., 2002). Overreliance on external motives can undermine intrinsic interest and promote surface learning (Ryan and Deci, 2000), while excessive competition may increase stress (Smith et al., 2005).

The link between self-efficacy and achievement aligns with previous research (Ortega-Torres et al., 2020; Keklik and Keklik, 2013). High self-efficacy students set challenging goals, persist, and use effective strategies; supportive teacher and peer environments enhance these effects (Schunk and Pajares, 2002). Self-efficacy also interacts with intrinsic and extrinsic motives. These findings show how students' confidence in their abilities pursue both growth and success (Saks, 2024) and thrives in collaborative classrooms that emphasize engagement over competition (Khan, 2024).

The positive association between strategy use and achievement supports SRL theory (Zimmerman, 2000). Cognitive strategies like repetition strengthen memory retention, as Ebbinghaus (1885) demonstrated, while spaced repetition improves long-term recall. Elaboration and organization promote deeper understanding by linking new and prior knowledge through paraphrasing, analogies, or concept mapping (Ruffin et al., 2024). Metacognitive strategies, such as self-monitoring and reflection, further enhance learning by allowing students to evaluate comprehension and adjust approaches (Panadero, 2022). Finally, peer learning supports achievement through collaborative engagement, consistent with Vygotsky's (1978) sociocultural theory. Group discussions, study groups, and peer tutoring foster shared knowledge construction, accountability, and motivation (Tran, 2019).

In sum, the results support the assertion that there are interactions between motivation and learning strategies within SRL, with self-efficacy, intrinsic goals, and metacognitive regulation playing critical roles in academic success.

Practical implications

The present findings have several practical implications. Regarding the decline in motivation across upper secondary school years, schools could implement programs that encourage goal setting and connect academic tasks to students' personal interests or future aspirations. Additionally, professional development for teachers could focus on

reinforcing organizational skills across all grade levels to prevent the observed decline. This decline in intrinsic motivation underscores the need for targeted interventions to sustain student engagement as they advance through secondary education.

Classroom goal structures are critical in supporting adaptive motivation and achievement among students. Mastery-oriented classrooms, emphasizing learning and effort, sustain intrinsic motivation and self-efficacy, countering adolescent motivation decline (Pintrich, 2004). Conversely, performance-oriented classrooms, focusing on competition and grades, may undermine intrinsic motivation (Deci et al., 1999). Teachers can counteract this by providing meaningful feedback and aligning tasks with students' interests.

The positive and generally moderate to strong associations between motivation, learning strategies, and academic achievement suggest that fostering these self-regulated learning components can meaningfully enhance students' performance. In particular, the strong relationship between self-efficacy and grades indicates that interventions aimed at strengthening students' confidence in their learning abilities may yield substantial academic benefits. Goal-setting, feedback, and providing opportunities for mastery experiences are practical means of improving academic achievement. Similarly, promoting intrinsic motivation, metacognitive regulation, and effort management could improve persistence and engagement across grade levels. Even smaller yet significant relationships (e.g., repetition, elaboration, organization) highlight that training students in diverse strategy use can cumulatively contribute to achievement. Overall, the findings support the implementation of instructional practices that explicitly cultivate motivational beliefs and learning strategies to enhance academic outcomes.

Encouraging learning strategies could improve academic outcomes. Teachers can integrate strategy instruction into curricula, teaching students how to use repetition effectively (e.g., spaced practice), elaborate through summarization or questioning, and organize information using graphic organizers. Effort management can be supported through goal setting and time-management workshops, while peer-learning can be encouraged through structured group activities like cooperative learning tasks (Johnson et al., 2020).

Limitations

Several limitations should be noted when interpreting the findings. The survey distribution relied on teachers' voluntary participation, and some teachers did not administer the questionnaire to their classes. As a result, not all students had an equal opportunity to participate, which may have introduced selection bias. The sample may therefore over represent certain classes or student groups while underrepresenting others. In addition, data were collected within intact classroom groups, potentially creating clustering effects that reduce the independence of individual responses. Finally, because the data were obtained from a single school, the generalizability of the findings to other educational contexts may be limited.

Another limitation is the cross-sectional design, which prevents causal inferences. While correlations between learning strategies, motivation, and grades are promising, correlation does not imply causation. Factors like socioeconomic status or teacher quality may mediate these relationships (Eccles and Wigfield, 2002). High grades

may also reinforce self-efficacy, creating feedback loops (Schunk and Pajares, 2002).

This study investigated motivation and learning strategies at a general level. However, the effectiveness of strategies like repetition or elaboration may vary by subject, with repetition suiting rote-learning disciplines like mathematics and elaboration fitting conceptual subjects like literature (Wild and Neef, 2024). Furthermore, the study's grade-level comparisons are limited by separate group analyses, needing longitudinal designs for stronger developmental insights. Finally, it may be argued that reliance on grades simplifies achievement, neglecting creativity or critical thinking (Biggs, 1999). Future research should use diverse outcome measures and subject-specific assessments of motivation and strategies.

Conclusion

Despite its limitations, this study offers several valuable contributions to understanding motivation and learning strategies. The study possesses several methodological strengths. The sample included more than 70% of the total student population, providing a high level of statistical power and internal validity. All students at the school were initially eligible for participation, ensuring that the sampling frame encompassed the entire population. Furthermore, data collection occurred in a natural school setting, which likely enhanced ecological validity and encouraged genuine engagement among participants. Taken together, these features strengthen the robustness of the findings and support the credibility of the study's conclusions.

This study successfully tested variables using a shorter version of the Motivated Strategies for Learning Questionnaire (MSLQ). Although the study measured motivation and learning strategies at a general level, it established significant relationships with academic achievement, thereby supporting the criterion validity of the measure. A key strength is the use of actual academic grades as a measure of achievement, providing a robust indicator of performance.

To build on these findings, future research could employ longitudinal or experimental designs to examine causal relationships between motivation, strategy use, and achievement. Additionally, investigating potential moderators, such as instructional context, academic domain, or feedback practices, could further elucidate how SRL processes operate across different learning environments. Interventions targeting specific strategies, such as elaboration or effort management, could be tested experimentally to assess their impact on grades and other outcomes.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors without undue reservation.

Ethics statement

Ethical approval was not required for the studies involving humans because this study does not include sensitive data. The studies were conducted in accordance with the local legislation and

institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

ÅD: Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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