Longitudinal effect of learning environment, learner motivation, and self-regulation strategies on EFL students' L2 achievement

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ABSTRACT: In this study, we explored the primary learning environment factors, motivation factors, and self-regulation strategies observed among elementary, junior high, and high school students in South Korea. Additionally, we investigated grade-level differences in these factors and their impact on English achievement by using structural equation modelling. We analyzed data from the Korean Education Longitudinal Study 2013, including the second year (sixth grade in elementary school), fifth year (third year in junior high school), and seventh year (second year in high school). The results reveal that as students progressed through different school levels, the factors influencing their English achievement varied. Specifically, self-regulation strategies, particularly behavioral regulation, consistently influenced English achievement regardless of school level. However, the direct impact of intrinsic motivation on learning English was observed only among high school students. This finding shows that factors directly affecting English achievement varied with changes in school level, which underscores the importance of educators and educational institutions recognizing the unique characteristics of students at different school levels. Moreover, it highlights the essential need to develop instructional strategies that enhance students' motivation levels according to the school level.
Keywords: structural equation modelling, longitudinal effect, English learning motivation.

Efecto longitudinal del entorno de aprendizaje, motivación del aprendiz y estrategias de autorregulación en el logro del L2 de estudiantes de inglés como lengua extranjera

RESUMEN: En este estudio, exploramos los principales factores del entorno de aprendizaje, los factores de motivación y las estrategias de autorregulación observados entre los estudiantes de primaria, secundaria y preparatoria en Corea del Sur. Además, investigamos las diferencias a nivel de grado en estos factores y su impacto en el rendimiento en inglés mediante el uso de modelos de ecuaciones estructurales. Analizamos datos del Estudio Longitudinal de Educación Coreana 2013, incluyendo el segundo año (sexto grado en la escuela primaria), el quinto año (tercer año en la escuela secundaria) y el séptimo año (segundo año en la preparatoria). Los resultados revelan que a medida que los estudiantes avanzaban en los diferentes niveles escolares, los factores que influían en su logro del inglés variaban.

Específicamente, las estrategias de autorregulación, particularmente la regulación conductual, influían consistentemente en el logro del inglés independientemente del nivel escolar. Sin embargo, el impacto directo de la motivación intrínseca en el aprendizaje del inglés se observó solo entre estudiantes de preparatoria. Este hallazgo muestra que los factores que afectan directamente el logro del inglés variaban con los cambios en el nivel escolar, lo que subraya la importancia de que los educadores y las instituciones educativas reconozcan las características únicas de los estudiantes en diferentes niveles escolares. Además, resalta la necesidad esencial de desarrollar estrategias instruccionales que mejoren los niveles de motivación de los estudiantes según el nivel escolar.

Palabras clave: modelado de ecuaciones estructurales, efecto longitudinal, motivación en el aprendizaje del inglés.

1. INTRODUCTION

In the English as a Foreign Language (EFL) setting, English input and output are primarily confined to classroom settings (Kim, 2018). When students' input and output are limited, individual differences such as motivation and learning strategies and their academic context significantly influence English proficiency (Winke & Gass, 2018). Several empirical studies have investigated the role of individual differences in learners' English proficiency (Kim & Kim, 2018; Yu, 2019). Among individual differences, second-language (L2) motivation is an important factor in helping learners put learning effort into learning L2, leading to successful L2 learning (Danesh & Shahnazari, 2020). In addition, the role of individual differences in L2 proficiency has been explored in relation to self-regulation strategies (e.g., Schunk & Zimmerman, 2023), parenting styles, relation with friends, and teaching methods (e.g., Lee & Han, 2022; Mercer, 2019).

However, individual differences are not fixed concepts; over time, they respond to various internal and external factors, constantly changing. Therefore, to examine how learners change over time, it is necessary to understand the impact of learner variables on English proficiency from a long-term perspective. Despite the importance of a longitudinal approach, the influence of individual differences on English academic achievement has not been fully investigated from a long-term perspective.

With these points in mind, applying structural equation modeling (SEM), this study aims to investigate how the structural relationships among learning environment, learning motivation, self-regulation strategies, and English achievement change over time with the same participants in South Korea (henceforth, Korea) when they advance school levels. Based on the results, this study provides practical implications for L2 teachers, policymakers, and practitioners regarding how to help L2 learners achieve their desired L2 proficiency. These results can help to recognize the unique characteristics of students at different school levels and develop tailored English teaching strategies and programs. The research questions are as follows:

1) What are the primary learning environment factors, motivation factors, and self-regulation strategies observed in elementary, junior high, and high school students in Korea?

2) Are there any grade-level differences among learning environment factors, motivation factors, self-regulation strategies, and English achievement?

2. LITERATURE REVIEW

2.1 L2 learning motivation and self-determination theory

Among individual variables, L2 learning motivation has been actively investigated in the field of educational psychology and TESOL. In particular, self-determination theory (SDT) (Deci & Ryan, 2000) explores motivational factors from the perspective of varying degrees of autonomy and control in terms of the reasons why individuals engage in activities. Based on the degree of self-determination, motivation can be categorized into varying subcategories of intrinsic motivation and extrinsic motivation in SDT. Extrinsic motivation includes integrated regulation, identified regulation, introjected regulation, and external regulation. Individuals with intrinsic motivation tend to engage in activities for the enjoyment of the activities themselves, without anticipating external rewards. On the other hand, those with extrinsic motivation participate in activities to obtain external rewards that are not directly related to the results of the learning behavior or to avoid punishment when they do not participate.

2.2 Self-regulation strategy

Self-regulated learning refers to learners' active cognitive and behavioral engagement in their learning process to achieve their learning objectives (Schunk & Zimmerman, 2023). Self-regulated learning encompasses both cognitive and behavioral strategies, where cognitive strategies involve planning and controlling one's cognitive processes according to the plan (Nam & Maeng, 2018) and behavioral strategies include managing learning-related resources such as time and space as well as seeking assistance (Lee et al., 2021).

2.3 L2 learning environment

Factors related to the learning environment include relationships with parents, teachers, and friends and classroom settings such as the L2 learning atmosphere and teaching methods. For example, regarding parents, empirical research has concentrated on examining the impact of parental involvement in a learner's academic pursuits on the learner's academic achievement. This investigation has particularly emphasized the significance of parental interest and support for the child's educational endeavors (Moon & Kim 2003; Wang et al., 2023).

Regarding teachers, studies have primarily examined the relationship between English academic achievement and whether teachers provide explanations and assignments tailored to students' levels during class, as well as the type of interaction with students (Akbari & Allvar, 2010; Kim & Seo, 2018). Bhatti et al. (2020) revealed a positive correlation between English academic achievement and classroom performance based on friends, specifically in relation to peer relationships and emotional attachment with peers. In summary, factors including learners' peer relationships, teacher variables, and a positive academic atmosphere ultimately lead to active participation in learning. This, in turn, has a statistically positive correlation with foreign-language enjoyment and, furthermore, foreign-language achievement (Li, 2022).

2.4 Individual differences and L2 achievement

In the present study, learner variables comprise self-determination, which refers to learners' motivation; self-regulation strategies, which include cognitive and behavioral regulation; and learning environment variables, which are the human and external environments related to learners' learning. Each of these various individual differences is expected to affect English achievement based on the results of previous research. For example, Hermessi (2023), using the structural equation modeling approach, found that individual factors such as intrinsic orientation and attitudes towards L2 and L2 learning experience have positive effects on EFL learning among 241 high school students of English in Tunisia. This is consistent with the findings of Cho (2011), who studied first-year junior high school students in South Korea using data from 2007, the third year of the Korean Education Longitudinal Study (KELS) 2005, and found that among motivational factors such as self-determination and self-regulation strategies, intrinsic motivation to learn is the strongest explanatory factor for individual academic achievement (Cho, 2011). Furthermore, in comparison to extrinsic motivation, intrinsic motivation has been linked with higher levels of self-regulated learning (Cho, 2014) and increased engagement in the classroom (Reeve, 2012).

Park and Kim (2022) and Zhou and Hiver (2022) examined the relationship between self-regulation strategies and English achievement and found that self-regulated learning has a significant impact on learning engagement (Zhou & Hiver, 2022) and English achievement (Park & Kim, 2022). Zhou and Hiver (2022) analyzed 800 Chinese university students' use of self-regulation strategies and engagement in English writing and found that learners' self-regulation strategies were a pivotal antecedent to their engagement in writing classes. Chen (2022) used a meta-analysis to analyze learners' self-regulation strategies and L2 achievement and revealed that learners' self-regulation strategies positively impact learners' L2 achievement.

Regarding parents as an interpersonal relationship within the learning environment, a study of junior high school students found that learners' perceived parenting style positively predicted academic enthusiasm (Lee & Han, 2022). Similarly, parental support of academics was found to positively impact intrinsic motivation for English (Fan & Williams, 2010). In the case of English-language subjects, parental socio-economic status and parenting style, as well as parents' beliefs and expectations about their children's English language learning, are positively associated with English language learning achievement (Butler & Le, 2018).

The student–teacher relationship also affects learners' engagement and comprehension. Mercer (2019) found that teacher characteristics such as friendliness, patience, and kindness improved the task engagement of foreign-language learners. Additionally, Zhou et al. (2023) found that students' perception of teachers' emotional support was one of the indicators for interaction engagement in L2.

The aforementioned domestic and international studies have shown that learner variables can positively impact overall academic performance and English language achievement. However, these studies have not provided a comprehensive view of how specific factors—such as learning environment, motivation, and self-regulation—interact across different school levels (elementary, junior high, and high school) in the context of English learning. Therefore, this study aims to analyze how each of these learner variables affects English language learning achievement as the same learner develops cognitively through elementary, junior high, and high school.

3. METHODS

3.1 Data

In this study, we analyzed data from the Korean Education Longitudinal Study 2013 (KELS 2013), a longitudinal study conducted by the Korean Educational Development Institute (KEDI) that tracked the same participants from 2013 to 2021. As this study is a longitudinal research conducted with Korean learners, a representative sample was drawn from the entire population of Korean learners. The sampling was proportional to the population sizes of students across 16 cities and provinces nationwide. Due to the nature of this long-term follow-up study, student consent for participation was essential, and only those who agreed to participate in the long-term follow-up were included in the final sample. In this regard, a stratified cluster random sampling method was utilized to construct the sample. In 2013, the first-year dataset was drawn from a total of 5,509 elementary schools nationwide, comprising 524,117 5th-grade students. From this initial sample, a total of 242 schools and 8,070 students were selected. Subsequently, 7,324 students who consented to participate in the study were included in the final sample. Our analysis, which excluded missing data, focused on information collected from 6,363 participants in the sixth year of elementary school (sixth graders) from the second-year dataset, 6,002 participants in the third year of junior high school (ninth graders) from the fifth-year dataset, and 3,915 participants in the second year of high school (11th graders) from the seventh-year dataset.

3.2 Data collection and analysis

3.2.1 Independent variables

The independent variables utilized in this study are presented in Table 1.

Table 1. *Independent variables*

Learning Environment	Learning Motivation		Self-regulation	
Parental support	Motivational preference	Intrinsic motivation (English)		Rehearsal
Teaching method (Individualized teaching)	Self-determination	Integrated regulation	Cognitive regulation	Elaboration
Teaching method (Interaction)		Identified regulation		Organization
Teacher enthusiasm		Introjected regulation		Metacognition
Relation with friends		External regulation		Learning performance
			Behavioral regulation	Effort management
				Time management
				Help seeking

This study recompiled and analyzed the results of pre-constructed questionnaires by the KEDI and extracted survey items related to the following three categories according to the research questions: 1) learning environment, 2) learning motivation, and 3) self-regulation (see Appendix). The learning environment factor consists of five components: parental support, teaching method (individualized teaching), teaching method (interaction), teacher enthusiasm, and relation with friends, and those were identified as independent variables through confirmatory analysis (GFI = .967, TLI = .971, CFI = .978, RMSEA = .053). Each component was measured with three items assessed on a five-point Likert scale. Parental support includes items related to parental academic support. Teaching method (individualized teaching) involves items related to teachers providing explanations and assignments tailored to students' levels, while teaching method (interaction) comprises items related to teachers' encouragement and advice. Teacher enthusiasm consists of items related to teachers' knowledge and enthusiasm, and relation with friends is composed of items related to peer attachment.

Learning motivation is divided into motivational preference and self-determination, having a total of six factors. As the data for this study was constructed to establish the basis for Korean education policy in general, the framework for understanding learning motivation was based on Self-Determination Theory (SDT), widely employed in educational research, rather than context-specific frameworks, such as Dörnyei's (2009) L2 motivational self-system. Those factors were identified as independent though a confirmative analysis (GFI = .928, TLI = .932, CFI = .942, RMSEA = .06). Motivational preference deals with learners' intrinsic motivation for learning English (henceforth, intrinsic motivation) and consists of three items assessed on a four-point Likert scale related to immersion and the perceived importance of English. Self-determination consists of four components of learners not only in English but also in all subjects: integrated regulation, identified regulation, introjected regulation, and external regulation. Each of these four components consists of three items assessed on a four-point Likert scale.

The specific items for self-determination were constructed according to Ryan and Deci's (2000) model of self-determination. For example, external regulation consists of questions about completing schoolwork because of teachers' or parents' criticism, physical punishment, or a sense of duty. Introjected regulation refers to performing according to the standards or rules set by others, such as friends or parents (Kim, 2013), and consists of items regarding students performing their studies because of how they appear to others. Identified regulation comprises largely internalized motivational factors (Ryan & Deci, 2000), and its items consist of perceptions of the value of gaining knowledge and real-life needs. Integrated regulation consists of items related to the joy of gaining knowledge and taking on challenges.

As previously mentioned, according to Schunk and Zimmerman (2023), self-regulated learning means that learners are actively involved in their own learning process, both cognitively and behaviorally, to achieve the learning goals they set for themselves. Self-regulated learning encompasses cognitive and behavioral strategies, where cognitive strategies are ways of planning students' own cognitive processes and controlling the learning process accordingly (Nam & Maeng, 2018) and behavioral strategies include resource management strategies related to learning, including managing time and space as well as asking for help (Lee et al., 2021). Therefore, to further analyze the impact of learners' self-regulated learning on their English language achievement, the items in this study were categorized into cognitive regulation and behavioral regulation. All of the eight components under self-regulation were

confirmed as independent through confirmatory factor analysis (GFI = .934, TLI = .943, CFI = .954, RMSEA = .052).

Cognitive regulation is composed of four components: rehearsal, elaboration, organization, and metacognition. Each component consists of three items assessed on a four-point scale. Rehearsal refers to memorization, and elaboration signifies connecting newly acquired knowledge with previous information. Organization is related to restructuring and summarizing what students learn. Metacognition involves confirming one's understanding of the learned material.

Behavioral regulation consists of four components: learning performance, effort management, time management, and help seeking. Each comprises three items assessed on a four-point scale. Learning performance includes setting learning goals and managing the learning process to achieve them. Effort management pertains to exercising perseverance. Time management is related to planning and utilizing time effectively, while help seeking involves interacting with friends when encountering difficulties in learning.

3.2.2 Dependent variables

English achievement, the dependent variable, was measured on a nine-point Likert scale. Because of potential challenges in estimation arising from substantial variance in the English achievement calculation methods for elementary, junior high, and high school students (Kline, 2006), all scores were converted to a one-to-nine scale. For elementary and junior high school students, English proficiency was assessed using the Diagnostic Tests of Basic Skills (DTBS), a nationwide test to diagnose students' basic academic abilities in English (elementary school students: 25 items; junior high school students: 26 items). Their scores were converted to a nine-point Likert scale based on the number of correct answers (e.g., 0–19 points = 1, 20–29 points = 2, ... 80–89 points = 8, 90–100 points = 9). High school students' English achievement was based on the mock College Scholastic Ability Test (CSAT). Specifically, although a score of 90–100 points corresponds to a grade of 1 according to the mock test absolute evaluation criteria in Korea, in this study, it was reverse-coded, assigning a score of 9. Likewise, the original grade of 9 corresponding to 0–20 points was recoded to a score of 1.

3.3 Proposed structural model

The expected structural modeling among learning environment, learning motivation, self-regulation, and L2 achievement is presented in Figure 1, considering Kim and Kim (2021) and Zhou and Hiver's (2022) previous studies. Learning environment factors such as parents, learning atmosphere, and school atmosphere are expected to positively influence L2 learning motivation, self-determination, and self-regulation (Getie, 2020). In addition, L2 learning motivation and self-determination are expected to positively influence the usage of self-regulation strategies (Cho, 2014) and L2 achievement (Kim & Kim, 2021; Hermessi, 2023). Self-regulation strategies are expected to positively influence L2 achievement (Chen, 2022).
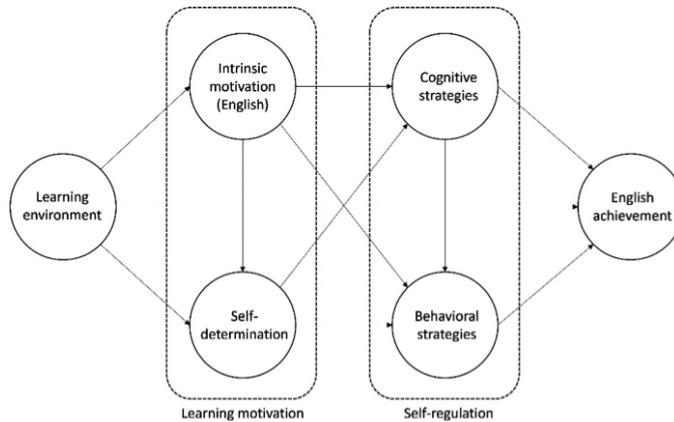
Figure 1. *Proposed structural model*

3.4 Data analysis

Descriptive statistics were performed using SPSS 23.0, and the analysis regarding the proposed structural model was performed using AMOS 21. To analyze the reliability of factors such as learning environment, intrinsic motivation, self-determination, cognitive regulation, and behavioral regulation across different school levels, Cronbach's alpha co-efficients were examined. Pearson correlation analysis was also conducted to confirm the correlations between factors.

With the factors identified as correlated, using AMOS, path analysis was conducted separately for each school level to examine the paths among learning environment, learning motivation, self-regulation strategies (e.g., cognitive and behavioral regulation), and English achievement. Based on the results of the path analysis, a structural equation model for the relationships was derived. Subsequently, paths within the structural equation model were compared across different school levels. Additionally, differences in learner factors that significantly influence English achievement within the learning environment, learning motivation, and self-regulation strategies were compared and analyzed across each school level.

4. RESULTS

4.1 Descriptive statistics

The descriptive statistics for the dependent and independent variables in this study as well as their reliability are presented in Table 2. The reliability of the measured variables ranged from .93 to .774. For English achievement, there was no reliability (-) as it was represented by a single measurement variable.

Table 2. *Descriptive statistics*

Variable	Factors	School Level	*n*	*M*	*SD*	Min.	Max.	Cronbach's alpha
Learning environment	Parental support	Elementary	6,363	2.99	0.99	1	5	0.758
		Junior high	6,002	3.11	0.94	1	5	0.774
		High	3,915	2.88	0.97	1	5	0.775
	Teaching method (Individualized teaching)	Elementary	6,363	3.85	0.85	1	5	0.883
		Junior high	6,002	3.54	0.86	1	5	0.906
		High	3,915	3.48	0.85	1	5	0.89
	Teaching method (Interaction)	Elementary	6,363	3.80	0.91	1	5	0.895
		Junior high	6,002	3.58	0.85	1	5	0.865
		High	3,915	3.59	0.80	1	5	0.82
	Teacher enthusiasm	Elementary	6,363	4.27	0.70	1	5	0.901
		Junior high	6,002	4.04	0.75	1	5	0.889
		High	3,915	4.03	0.72	1	5	0.877
	Relation with friends	Elementary	6,363	3.98	0.77	1	5	0.906
		Junior high	6,002	4.05	0.71	1	5	0.93
		High	3,915	4.07	0.66	1	5	0.92
Learning motivation — Motivational preference	Intrinsic motivation	Elementary	6,363	3.00	0.73	1	4	0.874
		Junior high	6,002	2.79	0.74	1	4	0.849
		High	3,915	2.80	0.69	1	4	0.819
Learning motivation — Self-determination	Integrated regulation	Elementary	6,363	1.71	0.64	1	4	0.868
		Junior high	6,002	1.69	0.63	1	4	0.865
		High	3,915	1.52	0.57	1	4	0.86
	Identified regulation	Elementary	6,363	2.15	0.75	1	4	0.795
		Junior high	6,002	2.19	0.72	1	4	0.789
		High	3,915	2.16	0.74	1	4	0.785
	Introjected regulation	Elementary	6,363	3.10	0.66	1	4	0.825
		Junior high	6,002	2.83	0.68	1	4	0.807
		High	3,915	2.73	0.70	1	4	0.816
	External regulation	Elementary	6,363	2.70	0.76	1	4	0.878
		Junior high	6,002	2.39	0.76	1	4	0.876
		High	3,915	2.33	0.74	1	4	0.868

Variable	Factors	School Level	n	M	SD	Min.	Max.	Cronbach's alpha
Self-regulation (Cognitive regulation)	Rehearsal	Elementary	6,363	2.54	0.64	1	4	0.78
		Junior high	6,002	2.49	0.65	1	4	0.808
		High	3,915	2.49	0.67	1	4	0.808
	Elaboration	Elementary	6,363	2.91	0.63	1	4	0.807
		Junior high	6,002	2.75	0.64	1	4	0.789
		High	3,915	2.77	0.64	1	4	0.784
	Organization	Elementary	6,363	2.93	0.66	1	4	0.82
		Junior high	6,002	2.85	0.67	1	4	0.851
		High	3,915	2.91	0.68	1	4	0.848
	Metacognition	Elementary	6,363	2.94	0.66	1	4	0.856
		Junior high	6,002	2.94	0.65	1	4	0.862
		High	3,915	3.00	0.62	1	4	0.838
(Behavioral regulation)	Learning performance	Elementary	6,363	2.89	0.67	1	4	0.853
		Junior high	6,002	2.76	0.66	1	4	0.849
		High	3,915	2.79	0.65	1	4	0.822
	Effort management	Elementary	6,363	3.21	0.58	1	4	0.886
		Junior high	6,002	3.06	0.61	1	4	0.876
		High	3,915	3.03	0.63	1	4	0.876

For elementary school students, the correlations were significant at the .01 and .05 levels, except for the relationship between introjected regulation in self-determination and the four items related to behavioral regulation and English-language proficiency. For junior high school students, we found significant relationships between all variables at the .01 level. For the high school students, we found significant relationships between all variables at the .01 level, except for the correlations between introjected regulation in self-determination and teaching method (individualized teaching) and introjected regulation and teaching method (interaction).

4.2 The primary learning environment factors, motivation factors, and self-regulation strategies

In examining the primary learning environment factors, motivation factors, and self-regulation strategies among elementary, junior high, and high school students in Korea, our findings reveal distinct patterns across these different stages of education. In the domain of learning environment, elementary school students attributed their positive learning environment largely to teacher enthusiasm ($M = 4.27$, $SD = .70$). Conversely, both junior high and high school students prioritized their relationships with friends, rating it significantly high at 4.05 ($SD = .71$) and 4.07 ($SD = .66$), respectively. When considering motivation factors, elementary students exhibited a strong inclination towards introjected regulation, scoring 3.10 ($SD = .66$), while junior high students showed a slightly lower score of 2.83 ($SD = .68$) in

the same category. In contrast, high school students demonstrated a preference for intrinsic motivation, with a mean rating of 2.80 (SD = .69).

Regarding cognitive self-regulation strategies, all of elementary (M = 2.94, SD = .66), junior high (M = 2.94, SD = .65), and high school (M = 3.00, SD = .62) showed preference for metacognition albeit with slight variations in mean ratings. Behavior strategies also demonstrated the same pattern, showing that the preference for effort management over learning performance remains consistent across all school levels (Elementary school: M = 3.21, SD = .58; Junior high: M = 3.06, SD = .61; high: M = 3.03, SD = .63).

4.3 Grade-level differences: Structural equation modeling analysis

In our investigation of grade-level differences among learning environment factors, motivation factors, self-regulation strategies, and English achievement, structural equation modeling (SEM) was employed to create structural equation models tailored to each school level. The results of a structural equation model with elementary school students are presented in Table 3, showing the standardized coefficients for each path. All individual path coefficients for factors influencing English achievement were found to be significant.

Table 3. *Standardized path coefficients between learner variables and English achievement for elementary school students*

| Pathway	Path coefficient (b)	SE	Standardized Coefficient	$t(p)$
Learning environment → Intrinsic motivation	0.591***	0.026	0.332***	23.03
Learning environment → Self-determination	0.527***	0.024	0.344***	22.389
Intrinsic motivation → Self-determination	0.352***	0.011	0.408***	31.638
Self-determination → Cognitive regulation	0.338***	0.011	0.646***	29.602
Intrinsic motivation → Cognitive regulation	0.05***	0.006	0.112***	8.91
Learning environment → Cognitive regulation	0.104***	0.011	0.13***	9.749
Self-determination → Behavioral regulation	0.103***	0.01	0.177***	10.451
Cognitive regulation → Behavioral regulation	0.759***	0.027	0.683***	28.387
Intrinsic motivation → Behavioral regulation	0.038***	0.005	0.077***	8.333
Learning environment → Behavioral regulation	0.119***	0.009	0.134***	13.134
Behavioral regulation →English achievement	1.516***	0.074	0.275***	20.44

Note: ***p < .001.

Among learning environment, intrinsic motivation, self-determination, cognitive regulation, and behavioral regulation, only behavioral regulation was identified as having a direct impact on English achievement (Table 4). Cognitive regulation, however, did not show any significant association with English achievement, leading to the removal of the arrow be-

tween cognitive regulation and English achievement. The influence of behavioral regulation on English achievement was found to be moderate, with a coefficient of .275.

Table 4. *Direct, indirect, and total effects of learner variables on English achievement in elementary school students*

Independent variable	Effect		
	Direct	Indirect	Total
Learning environment	.000	.157**	.157**
Intrinsic motivation	.000	.112**	.112**
Self-determination	.000	.170**	.170**
Cognitive regulation	.000	.188**	.188**
Behavioral regulation	.275**	.000	.275**

The structural relationship between learner variables for elementary school students and English achievement is presented in Figure 2. The goodness-of-fit indices for the model, including the above variables, were also confirmed to achieve a significant level (GFI = .925, TLI = .908, CFI = .923, RMSEA = .070).
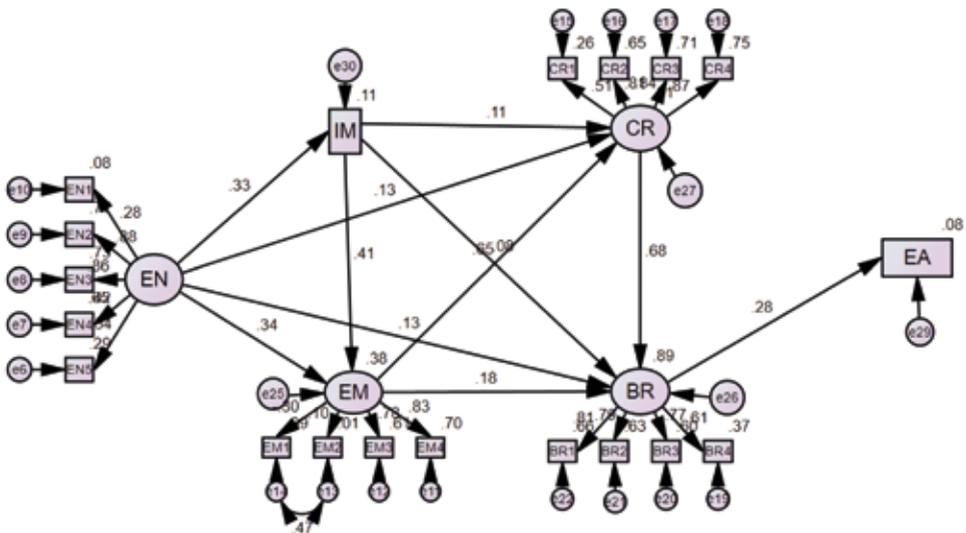
Figure 2. *The SEM of learning environment, motivation, self-regulation, and English achievement in elementary school students*

Note: EN1 = Parental support, EN2 = Teaching method (individualized teaching), EN3 = Teaching method (Interaction), EN4 = Teacher enthusiasm, EN5 = Relation with friends, EM1 = Integrated regulation, EM2 = Identified regulation, EM3 = Introjected regulation, EM4 = External regulation, CR1 = Rehearsal, CR2 = Elaboration, CR3 = Organization, CR4 = Metacognition, BR1 = Learning performance, BR2 = Effort management, BR3 = Time management, BR4 = Help seeking, EA = English Achievement.

The standardized path coefficients in the model for third graders of junior high school showed that the coefficients for each individual path of factors affecting English achievement were significant (Table 5), except for the path of cognitive regulation to English achievement.

Table 5. *Standardized path coefficients between learner variables and English achievement for junior high school students*

| Pathway	Path coefficient (*b*)	SE	Standardized Coefficients	*t(p)*
Learning environment → Intrinsic motivation	0.734***	0.03	0.372***	24.606
Learning environment → Self-determination	0.484***	0.026	0.298***	18.807
Intrinsic motivation → Self-determination	0.33***	0.011	0.401***	28.694
Intrinsic motivation → Cognitive regulation	0.068***	0.006	0.151***	10.975
Self-determination → Cognitive regulation	0.298***	0.011	0.542***	26.071
Learning environment → Cognitive regulation	0.138***	0.013	0.154***	10.763
Self-determination → Behavioral regulation	0.113***	0.01	0.179***	11.309
Intrinsic motivation → Behavioral regulation	0.053***	0.005	0.102***	9.796
Cognitive regulation → Behavioral regulation	0.763***	0.027	0.665***	28.544
Learning environment → Behavioral regulation	0.147***	0.011	0.143***	12.772
Behavioral regulation → English achievement	19.868***	2.994	0.297***	6.635
Cognitive regulation → English achievement	1.507	3.404	0.02	0.443

Note: ***p < .001.

Among the learning environment, intrinsic motivation, self-determination, cognitive regulation, and behavioral regulation factors in the data for junior high school students, only the cognitive and behavioral regulation factors were found to have a direct effect on English achievement (Table 6). However, for cognitive regulation, the direct effect was not significant, and the indirect effect (β = .197, p < .01) was significant. The direct effect of behavioral regulation on English achievement was significant (β = .297, p < .01), but the effect size of .297 indicated a moderate effect.

Table 6. *Direct, indirect, and total effects of learner variables on English achievement in junior high school students*

Independent variable	Effect		
	Direct	Indirect	Total
Learning environment	.000	.176**	.176**
Intrinsic motivation	.000	.132**	.132**
Self-determination	.000	.171**	.171**
Cognitive regulation	.020	.197**	.217**
Behavioral regulation	.297**	.000	.297**

Note: **p* < .01.

The structural relationship between learner factors and English achievement based on the data of junior high school students is presented in Figure 3. The fit of the model with the above factors is significant (TLI = .902, CFI = .920, RMSEA = .071).
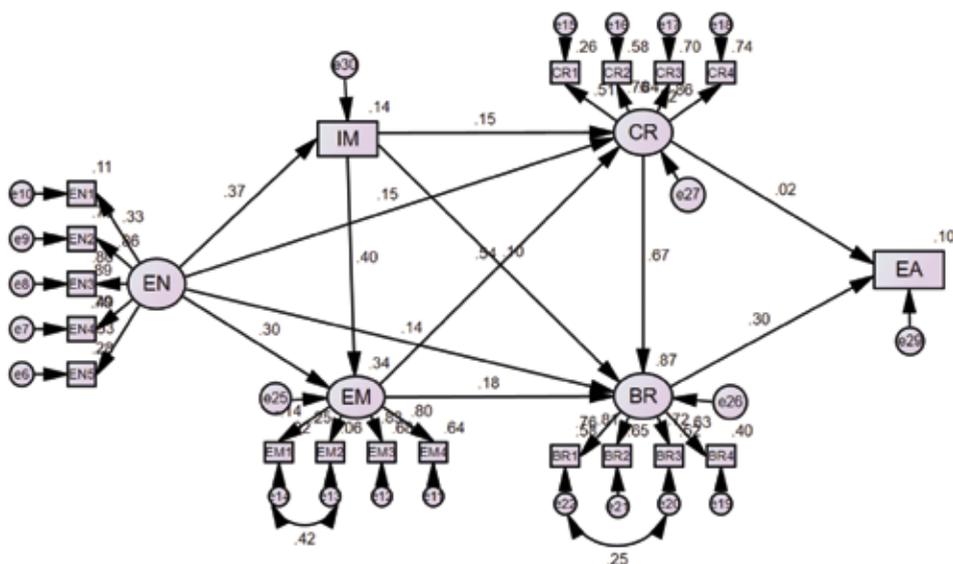
Figure 3. *The SEM of learning environment, motivation, self-regulation, and English achievement in junior high school students*

Note: EN = Learning environment, IM = Intrinsic motivation, EM = Self-determination, CR = Cognitive regulation, BR = Behavioral regulation, EA = English achievement, EN1 = Parental support, EN2 = Teaching method (individualized teaching), EN3 = Teaching method (Interaction), EN4 = Teacher enthusiasm, EN5 = Relation with friends, EM1 = Integrated regulation, EM2 = Identified regulation, EM3 = Introjected regulation, EM4 = External regulation, CR1 = Rehearsal, CR2 = Elaboration, CR3 = Organization, CR4 = Metacognition, BR1 = Learning performance, BR2 = Effort management, BR3 = Time management, BR4 = Help seeking.

The estimates of the path coefficients are presented in Table 7 as a result of analyzing the SEM considering the learner factors for high school students. Intrinsic motivation, cognitive regulation, and behavioral regulation were found to have a direct effect on English achievement among second graders of high school. However, the standardized coefficient of cognitive regulation on English achievement was not significant.

Table 7. *Standardized path coefficients between learner variables and English achievement for high school students*

Pathway	Path coefficient (b)	SE	Standardized Coefficients	t(p)
Learning environment → Intrinsic motivation	0.769***	0.041	0.361***	18.894
Learning environment → Self-determination	0.539***	0.038	0.278***	14.076
Intrinsic motivation → Self-determination	0.322***	0.016	0.353***	20.569
Intrinsic motivation → Cognitive regulation	0.088***	0.008	0.198***	11.049
Self-determination → Cognitive regulation	0.238***	0.012	0.491***	19.073
Learning environment → Cognitive regulation	0.139***	0.017	0.147***	8.014
Self-determination → Behavioral regulation	0.057***	0.012	0.095***	4.909
Intrinsic motivation → Behavioral regulation	0.054***	0.008	0.099***	6.994
Cognitive regulation → Behavioral regulation	0.912***	0.043	0.732***	21.21
Learning environment → Behavioral regulation	0.183***	0.018	0.156***	10.201
Intrinsic motivation → English achievement	0.685***	0.054	0.234***	12.638
Cognitive regulation → English achievement	0.454	0.392	0.069	1.157
Behavioral regulation → English achievement	0.981**	0.335	0.185**	2.931

Note: **$p < .01$. ***$p < .001$.

Among the learning environment, intrinsic motivation, self-determination, cognitive regulation, and behavioral regulation factors, only intrinsic motivation, cognitive regulation, and behavioral regulation were found to have a direct effect on English achievement in the high school data (Table 8). However, only intrinsic motivation and behavioral regulation showed significant direct effects. For cognitive regulation, the direct effect was not significant, and only the indirect effect was significant. When comparing the difference between the direct effects of intrinsic motivation and behavioral regulation, we found that intrinsic motivation

had a larger effect on English achievement than behavioral regulation, with a coefficient of .234 for intrinsic motivation and .185 for behavioral regulation.

Table 8. *Direct, indirect, and total effects of learner variables on English achievement in high school students*

Independent variable	Effect		
	Direct	Indirect	Total
Learning environment	.000	.212**	.212**
Intrinsic motivation	.234**	.100**	.334**
Self-determination	.000	.118**	.118**
Cognitive regulation	.069	.135*	.204**
Behavioral regulation	.185*	.000	.185*

Note: *p < .05. **p < .01.

The structural relationship between learner factors and English achievement based on the data of high school students is presented in Figure 4, and the fit of the model is significant (GFI = .931, TLI =.901, CFI = .921, RMSEA = .068).
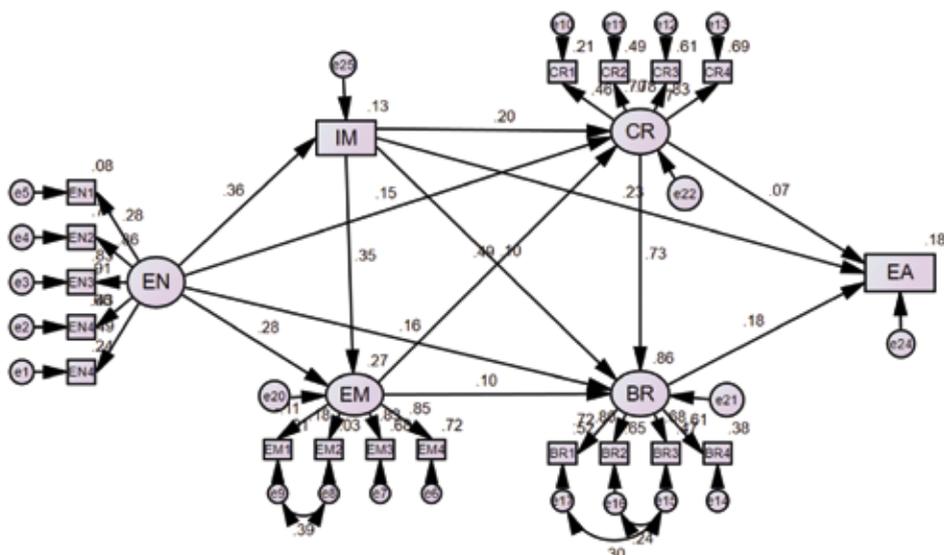
Figure 4. *The SEM of learning environment, motivation, self-regulation, and English achievement in high school students*

Note: EN = Learning environment, IM = Intrinsic motivation, EM = Self-determination, CR = Cognitive regulation, BR = Behavioral regulation, EA = English achievement, EN1 = Parental support, EN2 = Teaching method (individualized teaching), EN3 = Teaching method (Interaction), EN4 = Teacher enthusiasm, EN5 = Relation with friends, EM1 = Integrated regulation, EM2 = Identified regulation, EM3 = Introjected regulation, EM4 = External regulation, CR1 = Rehearsal, CR2 = Elaboration, CR3 = Organization, CR4 = Metacognition, BR1 = Learning performance, BR2 = Effort management, BR3 = Time management, BR4 = Help seeking.

To compare the effects of learner variables such as learning environment, intrinsic motivation, self-determination, cognitive regulation, and behavioral regulation on English achievement, we compared the path coefficients by school level. For behavioral regulation, the standardized path coefficient of behavioral regulation to English achievement was .28 at the elementary school level, .30 at the junior high school level, and .18 at the high school level. The size of the path coefficient was confirmed in the order of junior high, elementary, and high school. Compared to elementary and junior high school, the path coefficient of behavioral regulation is lower at the high school level because other factors such as cognitive regulation and intrinsic motivation also affect English language achievement.

When comparing the standardized path coefficients of cognitive regulation to English achievement between junior high school and high school, the coefficients were .02 at the junior high school level and .07 at the high school level. However, it was not found to be significant at either school level. Ultimately, the effects of rehearsal, elaboration, organization, and metacognition strategies on English achievement are not significant.

Intrinsic motivation was found to have a significant effect on English achievement only at the high school level. However, with an effect size of .23, the impact seems relatively small.

5. Discussion

5.1. Grade-level variations in learning environment, motivation, and self-regulation strategies

In our study examining the primary learning environment factors, motivation factors, and self-regulation strategies among elementary, junior high, and high school students in Korea, distinct patterns emerged. Regarding the learning environment, the contrasting perspectives of elementary, junior high, and high school students were noteworthy. While elementary students attributed their positive learning environment largely to teacher enthusiasm, junior high and high school students prioritized their relationships with friends. This divergence suggests that as students' progress through different educational stages, their perceptions of what constitutes an ideal learning environment evolve. When discussing motivational factors, elementary students exhibited a strong inclination towards introjected regulation, emphasizing external motivators. In contrast, high school students demonstrated a preference for intrinsic motivation. In the domain of self-regulation, metacognition as cognitive strategies and effort management as behavioral strategies emerged as a consistent self-regulation strategy across all school levels. Students recognized the importance of monitoring and reflecting on their learning processes. In addition, this suggests that students prioritized consistent effort and persistence, regardless of their grade level. Instructors can capitalize on this by promoting metacognitive practices and emphasizing the value of sustained effort.

5.2 Exploring structured models across school levels: Factors influencing English achievement

In our investigation, we constructed three structured models tailored to different school levels. By examining three structured models according to different school levels, we found

that the number of factors influencing students' English achievement increased as students pro-gressed through the different school levels. When examining the specific individual differences that influence English achievement, we found that the learning environment did not have a direct impact on English achievement. However, it indirectly influenced English achievement through intrinsic motivation. Additionally, the influence of the learning environment on English achievement became more significant as the school level advanced. These research findings suggest that as students advance school levels, the indirect impact of learning environment, such as teaching methods or teacher enthusiasm, on English achievement becomes more significant.

Moreover, the influence of intrinsic motivation on English achievement becomes more significant as students advance school levels. In particular, we found that intrinsic motivation indirectly influences English achievement during the elementary (.11) and junior high (.132) school periods. This differs from the findings of Cho (2011), which suggested the significant role of intrinsic motivation for Korean junior high school students in various individual dif-ference variables affecting academic achievement. This discrepancy highlights the importance of conducting further research to gain a deeper understanding of the dynamics of intrinsic motivation across diverse educational contexts and student populations.

We also found a significant effect of intrinsic motivation on English achievement for high school participants (.334). Especially, a direct impact of intrinsic motivation on English achievement was found among this population, unlike elementary and junior high school learners. These results are consistent with the research findings of Hermessi's (2023) study, showing a positive role of intrinsic motivation explaining English achievement among EFL high school learners. In addition, this tendency aligns with the results of Takahashi and Im (2020) in terms of Japanese university students and self-determination. Specifically, they reported that intrinsic motivation had the greatest impact on intentional learning effort and English achievement among the three types of motivation, including intrinsic motivation and introjected motivation. The findings of this study suggest that as the school level progresses toward university levels, learners' motivational preference, specifically intrinsic motivation, exerts a stronger influence on English achievement.

According to previous studies, self-regulation strategies have a significant and positive influence on learning engagement (Zhou & Hiver, 2022) and L2 academic achievement (Chen, 2022; Park & Kim, 2022). However, when self-regulated learning is analyzed by distinguishing between cognitive regulation and behavioral regulation, the impact of cognitive strategies and behavioral strategies on academic achievement tends to vary. For example, Manganelli et al.'s (2019) study with university students suggested that cognitive regulation strategies such as rehearsal, elaboration, and organization did not significantly explain academic achievement. However, according to Wolters and Hussain's (2015) study with university students, behav-ioral regulation strategies including learning effort and perseverance successfully predicted academic achievement. These inconsistencies emphasize the need to investigate which of the cognitive or behavioral regulation factors most effectively explains academic achievement.

In this study, self-regulation strategies were classified into cognitive and behavioral strategies, and behavioral strategies were found to directly influence English achievement. However, cognitive strategies were found to indirectly influence English achievement. Man-ganelli et al. (2019) found similar results indicating that cognitive strategies such as mem-orization, elaboration, and organization do not significantly impact academic achievement. In addition, our findings on the role of behavioral strategies such as active engagement,

exercising perseverance, and seeking assistance when faced with challenges are consistent with the results of Wolters and Hussain (2015). Moreover, perseverance, or the ability to endure, can assist learners in maintaining composure even in stressful situations (Teimouri et al., 2022). Given the demonstrated effects of interventions targeting well-being, grit, emotion regulation, and resilience on L2 learners' writing skills (Zhou et al., 2023), it becomes evident that equipping students with emotional regulation skills would be highly beneficial. However, it is noteworthy that while behavioral regulation played a direct role across different school levels in this study, its impact diminished as students progressed through the school levels. Understanding this trend has crucial implications for educators and institutions, emphasizing the need for evolving and adapting teaching methods to address the differing needs in terms of students' self-regulation as they navigate different educational stages.

6. CONCLUSION

This study investigated the primary learning environment factors, motivation factors, and self-regulation strategies among elementary, junior high, and high school students in Korea. By examining these, this study aimed to uncover patterns that shape students' educational experiences. Additionally, whether grade-level differences exist in learning environment factors, motivation, self-regulation strategies, and their impact on English achievement were explored by using structural equation modeling. The results indicate that as students progressed through different school levels, the factors influencing their English achievement varied with the accumulation of their learning experience. Specifically, self-regulation strategies, particularly behavioral regulation, consistently influenced English achievement regardless of the school level. However, the impact of intrinsic motivation for the English subject became gradually more significant as students advanced school levels.

These findings underscore the need for educators and educational institutions to recognize the unique characteristics of students at different school levels and develop tailored English teaching strategies and programs. For example, the significance of behavioral regulation in elementary school students' English achievement suggests that providing stress coping strategies, such as techniques for handling moments of tension, could be a proactive approach to fostering successful L2 learning (Sotardi, 2016). In the case of junior high school students, the role of cognitive strategies was validated to affect their L2 learning. To elaborate, incorporating a rehearsal stage before L2 group discussions was shown to enhance participation and fluency in language group discussion tasks (Stroud, 2021). High school students were found to be influenced by intrinsic motivation and self-regulation strategies.

Considering the unique role of intrinsic motivation, one strategy for boosting L2 learning motivation is to integrate visual materials into the learning process, as indicated by Safdari (2021). The use of visual aids, such as images, videos, or other visual resources, is proposed as a strategy to enhance students' engagement and interest in the L2 learning process. Visual materials can contribute to a more dynamic and immersive learning experience, potentially boosting intrinsic motivation for L2 learning.

However, despite the significant advantage of a longitudinal study that tracked 6,363 elementary school students nationwide up to their high school years (3,915 participants), this study has the following limitations. Since the factors were analyzed solely through quantitative questionnaire analysis, it is challenging to identify the detailed underlying causes and

specific external and internal circumstances behind these changes from elementary school to high school. In this regard, qualitative analysis should follow that tracks and observes these long-term changes to explore the phenomena surrounding English learning and proficiency improvement among learners in South Korea. As we analyzed pre-constructed questionnaire, which was developed to collect foundational data for the formulation, implementation, and performance evaluation of South Korea's educational policies (KELS, 2013), this study has the limitations of not including various motivational theories such as L2 motivational self-system (Dörnyei & Ushioda, 2021). Future studies may include those constructs to comprehensively deal with the impact of motivation on academic achievement.

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8. APPENDIX. QUESTIONNAIRE ITEMS

Factor		Items
Learning Environment	Parental support	Q39-2. My parents check my schoolwork and homework.
		Q39-3. My parents teach me how to study directly.
		Q39-4. My parents give me advice on how to study.
	Teaching method (individualized teaching)	Q13-2. My teacher checks my understanding in class.
		Q13-3. My teacher assigns work according to my ability.
		Q13-4. My teacher explains things according to my level of understanding.
	Teaching method (Interaction)	Q13-5. My teacher praises me often, which makes me feel more motivated to study.
		Q13-6. My teacher encourages me to challenge myself even if the problem is a little difficult.
		Q13-8. My teacher is kind enough to explain things again when I ask questions that I don't understand.
	Teacher enthusiasm	Q17-1. My teacher teaches the students with passion.
		Q17-2. My teacher is a good example to follow.
		Q17-3. My teacher is knowledgeable about the subject matter.
	Relation with friends	Q18-1. My friends think my ideas are good when we talk.
		Q18-2. My friends pay attention to what I say.
		Q18-4. My friends understand me well.
Motivational preference	Intrinsic motivation	Q1-7. When I study English, I usually go deep into it.
		Q1-8. English is an important subject for me.
		Q1-9. I won't stop learning English because I find it fun.
Self-determination	External regulation	Q3-2. I study because my teacher will punish me (scolding, corporal punishment) if I don't study.
		Q3-3. I study because my parents tell me to do so.
		Q3-4. I study because my teacher tells me to do so.
	Introjected regulation	Q3-6. I study because I am embarrassed if I get bad grades.
		Q3-7. I study because I don't want my parents to be disappointed.
		Q3-8. I study because I want my friends to see me as a smart student.
	Identified regulation	Q3-10. I study because I believe that gaining knowledge is a worthwhile endeavor.
		Q3-11. I study because studying helps in real life.
		Q3-12. I study because it helps me understanding harder things easier when I study later.
	Integrated regulation	Q3-14. I study because I find joy in facing challenges.
		Q3-13. I study because I enjoy studying.
		Q3-15. I study because it is fun to increase my knowledge.

Factor		Items
Cognitive regulation	Rehearsal	Q7-1. I try to memorize everything when I study.
		Q7-2. I memorize as much as I can when I study.
		Q7-3. When I study, if I learn something new, I memorize it until I can say it without looking at it.
	Elaboration	Q7-5. I study better when I connect new things to what I already know.
		Q7-4. I think about how I can use what I learn in real life when I study.
		Q7-6. I think about how I can link what I'm studying to what I already know.
	Organization	Q7-7. I organize what I study in my own way.
		Q7-8. I take notes of important information when I study.
		Q7-9. I put concepts together and make my own connections when studying.
	Metacognition	Q7-10. When I study, I make sure to remember what I learned.
		Q7-11. When I read a book, I try to figure out if there is anything I don't already understand clearly.
		Q7-12. When I study, I make sure to remember the most important things.
Behavioral regulation	Learning performance	Q8-2. I set goals and study with those goals in mind.
		Q8-3. I choose or create my own study topics or exercise questions.
		Q8-5. I plan, check, and evaluate myself when solving exercise questions.
	Effort management	Q9-1. I try my best when I study.
		Q9-2. I do not give up and continue to study even if the study material is hard.
		Q9-3. I do my best to learn what my teacher is teaching me.
	Time management	Q10-1. I make good use of time outside of class to study the subject matter.
		Q10-2. I stick to my planned study schedule.
		Q10-3. I spend enough time on my studies.
	Help seeking	Q10-8. I ask other students (friends) questions about things I do not understand in class.
		Q10-9. I try to find friends I can ask for help if I need it.
		Q10-10. If I don't understand something, I ask someone for help.