Self-regulation of learning in Chilean primary school students: Validation of an instrument and differences by sex and grade

Autorregulación del aprendizaje en estudiantes chilenos de educación primaria: validación de un instrumento y diferencias por sexo y grado

Fabiola SÁEZ-DELGADO, PhD. Assistant Professor. CIEDE-UCSC Education and Development Research Centre. Universidad Católica de la Santísima Concepción, Chile (*fsaez@ucsc.cl*).

Javier MELLA-NORAMBUENA, MPsych. Part-time Professor. Universidad Técnica Federico Santa María, Chile (*javier.mellan@usm.cl*).

Marcela BIZAMA, PhD. Associate Professor. CIEDE-UCSC Education and Development Research Centre. Universidad Católica de la Santísima Concepción, Chile (mbizama@ucsc.cl).

Joan GATICA. Doctoral student in Education. Universidad Católica de la Santísima Concepción, Chile (*jgatica@doctoradoedu.ucsc.cl*).

Abstract:

Self-regulated learning has been widely praised as a key competence for initiating and maintaining lifelong learning. However, despite its recognised value, the literature shows that it is still insufficiently rooted in schools and that students do not develop it automatically. The aim of this study was to validate an instrument for measuring self-regulation of learning in primary school students and to analyse differences in students' self-regulation of learning processes by sex and grade. The method was developed from a positivist paradigm and a quantitative approach. The sample consisted of 514 students from third to eighth grade of primary school in Chile. The results showed that the instrument has an acceptable structure [$\chi^2/df = 3.55$, $p < 0.001$; CFI = 0.974; TLI = 0.972; AGFI = 0.973; SRMR = 0.079; RMSEA = 0.071]. It consists of 56 items and 7 related factors, with Cronbach's alpha values over .7 and AVE index over .5 in all cases, which is acceptable. Significant differences were detected in the *self-regulation of study and learning* and *self-efficacy for disposition to study* variables, where women displayed higher levels than men. Also, in the *strategies for*

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disposition to study and *self-efficacy for disposition to study* variables, at the seventh and fourth grade levels, with the latter having higher levels. The discussion presents the potential practical implications, possibilities for research directed at timely intervention, and the impact on the quality of school education. It is concluded that girls have better self-regulation than boys, that self-regulation levels are suboptimal, and that self-regulation does not increase during the primary school years without intentional training.

Keywords: self-regulation of learning, primary education, public schools, quantitative approach.

Resumen:

El aprendizaje autorregulado ha sido muy elogiado como competencia clave para iniciar y mantener el aprendizaje permanente. Sin embargo, a pesar de su reconocido valor, la literatura ha evidenciado que aún no está arraigado lo suficiente en las escuelas y que no se desarrolla de forma automática en el estudiantado. El objetivo de este estudio fue validar un instrumento para medir la autorregulación del aprendizaje en estudiantes de educación primaria y analizar diferencias en los procesos de autorregulación del aprendizaje en el estudiantado según el sexo y el grado. El método se desarrolló desde un paradigma positivista y un enfoque cuantitativo. La muestra estuvo compuesta por 514 estudiantes de tercero a octavo grado de educación primaria en Chile. Los resultados mostraron que el instrumento tiene una estructura aceptable [χ^2/gl = 3.55, p <0.001; CFI = 0.974; TLI = 0.972; AGFI = 0.973; SRMR = 0.079; RMSEA = 0.071], constituida por 56 ítems y 7 factores relacionados. En todos los casos, se obtuvieron valores de alfa de Cronbach sobre .7 y un índice AVE sobre .5, que es lo aceptable. Se detectaron diferencias significativas en las variables *autoevaluación del estudio y aprendizaje* y *autoeficacia para la disposición al estudio*, donde las mujeres presentaron mayor nivel que los hombres. También en las variables *estrategias de disposición al estudio* y *autoeficacia para la disposición al estudio*, en los niveles de séptimo y cuarto grado, a favor de estos últimos. La discusión presenta las posibles implicaciones prácticas, la investigación orientada a la intervención oportuna y el impacto en la calidad de la educación escolar. Se concluye que las mujeres son más autorreguladas que los hombres, que los niveles de autorregulación son subóptimos y que, si esta no se entrena de manera intencional, no aumenta durante los cursos de la educación primaria.

Palabras clave: autorregulación del aprendizaje, educación primaria, escuelas públicas, enfoque cuantitativo.

1. Introduction

1.1. The importance of self-regulation of learning in education

The new requirements relating to key competences of students in this knowledge-based society have resulted in a large amount of research into how to make learning more effective. Self-regulation of learning (SRL) is a solid research construct, given that it has been developed to meet these demands (Anthonysamy et al., 2020; Oates, 2019).

According to Winne (2005), the first article to use the SRL construct was a study published by Mlott *et al.* in 1976. This term largely emerged from a sociocognitive perspective (Hadwin & Oshige, 2011; Zimmerman, 2013). Research into SRL intensified from the mid-1980s, especially in the educational context, and it acquired great prominence in the 1990s. The importance of conceptualising SRL was based on the opportunity to comprehend human thought, behaviour, and emotions in a focus that integrates different constructs gaining strength in its evolution (Weinstein, 1996). The path of its development even overtook other constructs that were the subject of research, such as metacognition, which had little fertilisation given that the majority of the SRL models that were starting to be proposed incorporated it (Dinsmore et al., 2008). In fact, it had already been observed that SRL consisted of a series of interrelated cognitive, affective, and motivational processes (Boekaerts, 1999; Pintrich, 2004; Niemivirta, 2006).

Students who can self-regulate have the necessary skills to learn effectively both in school and later on in life (Rivers et al., 2022). Consequently, SRL has been widely praised as the key competence for starting and maintaining lifelong learning (Taranto y Buchanan, 2020). Its introduction has been accompanied by a change of paradigm in research into learning and instruction, resulting in a focus on each student as an active participant in the process of learning.

1.2. Theoretical models and conceptualisation of SRL

SRL is recognised in specialist literature as a complex multidimensional construct and an extraordinary umbrella covering a large number of variables that influence learning from a global and holistic focus. The concept of SRL has been formulated as a synthesis of research into how learning functions (centred on cognitive and motivational processes of students) and research on how teaching functions (centred on interactions between students and teachers in a social setting). As a result, different proposals for theoretical models have emerged over time to explain this construct. Some theoretical reviews have analysed the available models (see, for example: Panadero, 2017; Puustinen & Pulkkinen, 200; Ribeiro & Boruchovitch, 2018), where at least nine models have been identified that integrate (meta) cognitive, motivational, and affective components, although the preponderance of these components varies in each of them. For example, some models emphasise cognitive aspects (Borkowski et al., 2000; Efklides, 2011; Hadwin et al., 2011; Winne & Hadwin, 1998; Zimmerman, 2000); some, motivational aspects (Perels et al., 2005; Pintrich, 2000; Schunk, 2001); and others, emotional ones (Boekaerts, 1991).

Although there are different SRL models, a variety of terminologies, and overlapping concepts, they do all agree that it is a dynamic process that functions in different phases (Puustinen y Pulkkinen, 2001). Specifically, analyses of the conceptual similarities of these models have made it possible to organise and demarcate the self-regulation processes in three phases: the pre-action

phase (disposition or planning); the action phase (performance or execution); and the post-action phase (self-evaluation or self-reflection) (Panadero, 2017; Puustinen y Pulkkinen, 2001). The planning phase involves processes such as task analysis, setting objectives where students incorporate contextual information, self-knowledge, and deployment of motivational beliefs (processes prior to the act of learning). Based on the obtained results, the performance phase then underlines self-regulation actions, such as supervising the achievement of the study and learning objectives that are set (processes during the act of learning). Finally, the self-evaluation phase is where reflection on the action takes place and the outcome of the learning activity is evaluated (processes after the act of learning) (Zimmerman, 2016). Given that SRL is defined as cyclical, the results of the self-evaluation phase can be used to adjust later processes of planning with new contributions; that is to say, new inputs when facing a new academic challenge (De Smul et al., 2019). For this reason, it should be noted that SRL involves planning, follow-up, and monitoring of one's own learning to make it more effective. The theory of SRL is built on the idea that monitoring learning falls to each student, who regulates his or her actions to achieve a given objective, such as, for example, accomplishing a task (Dignath y Veenman, 2021).

1.3. Empirical evidence on SRL

The importance of SRL has been shown by favourable educational results in primary education, where use of self-regulation strategies by students is associated with solid learning and effective academic performance. In contrast, students who are not able to self-regulate their learning, effort, and precision display suboptimal academic results and learning (Molenaar et al., 2019).

Literature has also underlined the relevance of SRL for motivation. For example, a study of 480 students in the fourth grade of primary education in Spain found from their results that SRL, with dimensions comprising planning, self-testing, and effort, displayed significant relations (p <.001) with intrinsic motivation (r = .39, r = .38, and r = .43 respectively) (Rodríguez-González et al., 2021). Another study involving 523 Hong Kong fourth-grade primary school students showed that all of the motivation variables (interest, self-efficacy, and growth mentality) were related to the use of SRL strategies (planning, self-control and acting on feedback) (.47 ≤ r ≤ .82, p < .001) (Bai & Guo, 2019).

The findings of studies that included motivation, self-regulation, and performance in primary education confirm direct and significant relationships. For example, a study of 238 ninth-grade students from the Sultanate of Oman showed the existence of statistically significant and positive relationships between SRL and intrinsic motivation (r = .57, p <0.05.), as well as between SRL and academic performance in mathematics (r = .58, p <0.05) (El-Adl

& Alkharusi, 2020). Another research with fourth-grade students in Hong Kong found positive relations between all of the motivational beliefs (growth mentality, self-efficacy, and intrinsic value), the three types of SRL strategies (supervision, regulation of effort, and setting and planning objectives), and scores in English exams ($.26 \leq r \leq .74$, $p < .01$) (Bai & Wang, 2023). Similarly, a study of 80 sixth- and seventh-grade students found that their perceived experience in the transition from primary to secondary school was significantly correlated with their SRL (Uka & Uka, 2020). That is to say, the way in which students experience a particular transition affects their motivation and academic performance.

On the basis of empirical studies, systematic reviews, and meta-analyses, it can be confirmed that SRL is associated with learning behaviour, performance, motivation, interpersonal behaviour, mental health, and a healthy adult life (Dent y Koenka, 2016; Dignath et al., 2008; Donker et al., 2014; Ergen y Kanadli, 2017; Öz, 2021; Robson et al., 2020; Theobald, 2021; Xu et al., 2022). The researches include students from all age groups and all types of contexts, which suggests that all pupils should have the opportunity to learn to self-regulate their own learning.

Given the above, attention is increasingly focussed on how to promote SRL at early ages. Its benefits for students are undeniable and they associate with notable or successful academic trajectories in all disciplinary or content areas, as confirmed by recent systematic reviews and meta-analyses. For example, findings from a systematic review of 36 studies of school-aged students supported the efficacy of the SRL interventions to increase academic performance in mathematics (Wang & Sperling, 2020). Another meta-analysis of 30 studies confirmed that SRL training programmes for primary school students have an effect on performance (Dignath et al., 2008).

However, the literature has also identified difficulties with promoting SRL in this educational stage. These include ones associated with how likely teachers are to respond to the diverse characteristics of their students, which can obscure the true SRL requirements, restricting opportunities for growth (Peeters et al., 2016). Also, the little time teachers explicitly dedicate to teaching SRL strategies, something that could be attributed to their beliefs or knowledge of their promotion (Dignath & Büttner, 2018). The challenges of promoting SRL in students with a low socioeconomic level or who are of migrant backgrounds has also been noted (Vandevelde et al., 2017). In addition, some authors have noted the importance of the theoretical background on which interventions for promoting SRL are based, as well as the type of instruction strategy, given that differing effects have been found when comparing different school levels, for example, in secondary education (Dignath & Büttner, 2008).

1.4. The present study and research objectives

The value of SRL is beyond doubt and both educational theory and practice agree that it is a key competence for lifelong learning that students must acquire from their early schooling (Dignath y Veenman, 2021). However, various studies have found that it is insufficiently rooted in schools and that teachers only rarely promote it among their students (Heirweg et al., 2022). The literature has also shown that students differ in their capacity for self-regulation, and that it does not develop automatically in them (De Smul et al., 2019). In fact, some students do not acquire a command of learning activities or use them independently.

Systematic literature reviews reveal that studies into SRL are mainly concentrated in Europe with very few in Latin America (Hernández y Camargo, 2017; López-Angulo et al., 2020). In addition, another systematic review of the literature, in this case about the instruments available for measuring SRL in students at different educational levels (Leon-Ron et al., 2020), found a lack of valid instruments for primary education. In the 40 studies analysed, 31 instruments were identified. However, only one was for primary education students. Moreover, it was in English and consisted of 75 items, which made it difficult for primary school students to complete due to its length. Although there may be other instruments for measuring SRL in primary education, the review by León-Ron et al. (2020) notes that they are few.

On the basis of the above information, this study set out three specific objectives: (1) to confirm the dimensional structure and reliability of an instrument for measuring SRL in primary education students in Chile, (2) to analyse differences in SRL processes by sex and (3) to analyse differences in the SRL processes by grade.

2. Method

The study was carried out with a positivist paradigm and a quantitative focus. An instrumental design was used for objective 1 of this study, while for objectives 2 and 3 a correlational descriptive cross-sectional design was used (Ato et al., 2013).

2.1. Participants

The sample comprised 514 students from grades three to eight of primary education in the Biobío region of Chile (see Table 1). Non-probability convenience sampling was used, as schools were invited to take part in the research. Three exclusion criteria were used: (a) repeating students (ones who are taking a grade for the second time); (b) first and second grade students, as they are still learning to read and write and so might have difficulties understanding items; and (c) students from the school integration system with a diagnosis of any special educational need linked to the components of cognitive and/or emotional development. The mean age was 11.92 (SD = 1.76). In relation to biological sex at birth, 272 (52.9%) students identified as male, 227 (44.2%) identified as female, and 15 (2.9%) students pre-

ferred not to say. With regards to the commune (area of a city) in which the school where they study is located, 238 students (46.3%) attend school in the commune of Concepción, 248 (48.2%) attend school in the commune of San Pedro de la Paz, and 28 (5.5%) attend school in the commune of Chiguayante.

TABLE 1. Descriptive statistics of the participants.

Level	Male	Female	Rather not say	Age (*SD*)
3rd Grade	24	20	0	8.73 (1.26)
4th Grade	11	17	1	9.86 (0.58)
5th Grade	57	43	5	10.84 (0.7)
6th Grade	73	50	4	11.93 (0.75)
7th Grade	46	35	4	12.65 (1.1)
8th Grade	61	62	1	13.93 (0.64)

Note: *SD* = standard deviation.

2.2. Instrument for measuring SRL

To measure the students' SRL, the self-regulation of learning phases instrument in secondary education (SRL-PI-S), by Sáez-Delgado et al. (2021), was selected. It had been developed on the basis of Zimmerman's theoretical model, which regards SRL as a three-phase cyclical process (forethought, performance, and self-reflection) (Zimmerman y Schunk, 2001). Its original design was applied to 438 Ecuadorian secondary school students, in a research programme with an instrumental design that included a review of specialist literature, validation by experts, with a Kappa coefficient of .92, and cognitive interviews (Sáez-Delgado et al., 2021). The tool consisted of seven independent Likert-type scales: (1) disposition to study strategies (DSS), comprising seven items; (2) execution scale (EXE), with seventeen items; (3) seeking help scale (SH), with three items; (4) self-reflection of study scale (SRE), with fourteen items; (5) self-efficacy for disposition to study scale (SEF), comprising seven items; (6) internal causal attribution scale (IA), comprising three items; and finally; (7) external causal attribution (EA), comprising five items. The scales are answered on a 7-point Likert-type answer scale, where 1 is «Never» and 7 is «Always». The confirmatory factor structure for secondary students displayed adequate indexes of fit in accordance with what is stated in the literature [RMSEA ≤.07; CFI and TLI >0.92, and SRMR <0.08]. The internal consistency is adequate given that Cronbach's alpha

was greater than 0.6 in all cases. The interpretation uses a focus of grouping the SRL level determined by the frequency of use of self-regulation strategies, in addition to the Likert-type answer scale from 1 to 7 points. Thus, the following three categories were specified: (a) students with optimal SRL levels (6-7 points); (b) students with suboptimal SRL levels (3-5 points); (c) students with insufficient SRL levels (1-2 points). In the present study, as part of its first objective, the SRLPI-S was adapted to give the SRLPI-P (self-regulation of learning phases instrument in primary education), which is a new version for measuring SRL for use in primary education in Chile. In so doing, we followed the international recommendations and standards for cultural adaptation and test validation. Finally, questions were included for administering the instrument that made it possible to obtain information about participants' sociodemographic variables (grade, sex, age).

2.3. Data collection procedure

Ethical principles for the conduct of research involving human subjects were followed. The fathers, mothers or legal guardians of each study participant signed an informed consent form, while the students, who were minors, signed an informed consent form. Both documents were approved by the Ethics and Bioethics Committee of the Universidad Católica de la Santísima Concepción (UCSC).

First, the cognitive interviews process was applied to a total de twelve students (seven girls and five boys) from five public schools in the Biobío region, with the objective of identifying possible problems understanding the instructions, wording of the items, and/or the instrument's answer format. There were no major observations and/or changes, as the students identified no difficulties in answering the instrument. They reported that the items were drafted in a simple, fluid, and direct way, and so understanding them did not cause any problems. Changes were only applied to those aspects where three or more students agreed.

2.4. Procedures for obtaining and analysing data

The first part of the analysis considered descriptive statistics of the sample. A confirmatory factor analysis was then performed to test the structure of the original scale and analyses were performed to evaluate differences by sex and educational level (year). All of them were done using the R software program (version 4.2.2).

For the confirmatory factor analysis, each scale was initially evaluated according to the structure proposed in the original study. Finally, three nested models were evaluated to test the general structure of the scale: (1) a structure with seven first-order factors; (2) a structure with seven correlated first-order factors; and (3) a hierarchical structure with one second-order factor and seven first-order factors. The ULS estimator was used, which is appropriate for ordinal measures such as Likert-type scales. The models were evaluated using chi-squared (χ^2), normed χ^2 (χ^2/df), CFI, TLI, AGFI, RMSEA, SRMR, and AVE.

The criteria used to evaluate the model were as follows: (1) χ^2/df between 2.0 and 5.0 (Hooper et al., 2008); (2) CFI and TLI greater than 0.9 is considered to be an acceptable fit and greater than .95 is a good fit; (3) RMSEA less than .05 is a good fit, between .05 and .08 is an acceptable fit, and greater than .08 is regarded as a poor fit; (4) SRMR less than 0.08 is regarded as an acceptable fit and less than 0.06 a good fit (Hu y Bentler, 1999); (5) AGFI, where a value close to 1 would indicate a perfect fit, while the minimum limit that is usually accepted is 0.8 (Bentler y Bonett, 1980).

To analyse reliability, we used Cronbach's alpha for each construct, where a value greater than 0.7 had to be obtained. Cronbach's alpha was also used if the item was eliminated from the model. As a complement for the analysis of convergent validity, the AVE (average variance extracted) index was used, where a value of .5 is considered acceptable (Fornell y Larcker, 1981).

To evaluate differences between the study variables by sex and grade, first the assumptions of normality and homoscedasticity were tested using the Kolmogorov–Smirnov test with the Lilliefors modification and the Levene test, respectively. The assumption of independence was fulfilled for the design of the study. To evaluate differences, we carried out Student's *t* tests or one-way ANOVA in the event that the necessary assumptions for the application of parametric tests were fulfilled. In cases where the assumptions were not fulfilled, the robust Yuen test or the trimmed means ANOVA were used as applicable.

3. Results

3.1. Objective 1 results

For the confirmatory factor analysis, we evaluated three nested models that consider the seven scales proposed in the original study: first, a unidimensional model (M1), then a hierarchical model with a general second-order factor with seven related factors (M2), and, finally, the model with seven related factors (M3).

When considering the χ^2/df criterion, model M3 displays $\chi^2/df = 3.55$, which is regarded as an acceptable fit. In contrast, the M1 and M2 models present values close to 6, which is outside the range established as acceptable. For the CFI and TLI indicators, the 3 models present good fit as they all have values greater than .95. Nonetheless, the M3 model has the highest values: 0.974 and 0.972, respectively. In the case of the SRMR and RMSEA indicators, only the M3 model presents acceptable values as both are lower than .8 (Table 2).

Table 3 shows the Cronbach's alpha values for each construct, Cronbach's alpha if the item is eliminated for each item in the model, and the AVE index. All of the constructs present Cronbach's alpha values of around .7, which is recommended. With regard to the possible variation when eliminating one item per construct, no items generate large variations. Finally, when evaluating the AVE index, all of the constructs are around .5, which is acceptable.

TABLE 2. Indicators of fit of the models.

Modelo	χ^2	χ^2/gl	CFI	TLI	AGFI	SRMR	RMSEA
M1: unidimensional	χ^2 (1128)= 6374.84, p <0.001	5.65	0.953	0.952	0.958	0.101	0.095
M2: jerárquico	χ^2 (1107)= 6563.30, p <0.001	5.92	0.952	0.949	0.956	0.102	0.098
M3: siete factores relacionados	χ^2 (1210)= 4301.52, p <0.001	3.55	0.974	0.972	0.973	0.079	0.071

Note: χ^2 = chi–square test; χ^2/df = chi-square divided by degrees of freedom; CFI = comparative fit index; TLI = Tucker Lewis index; AGFI = adjusted goodness of fit index; SRMR = standardised root mean-square; RMSEA = root mean square error of approximation; M = model.

TABLE 3. Indicators of reliability (α) and convergent validity (AVE) of the instrument.

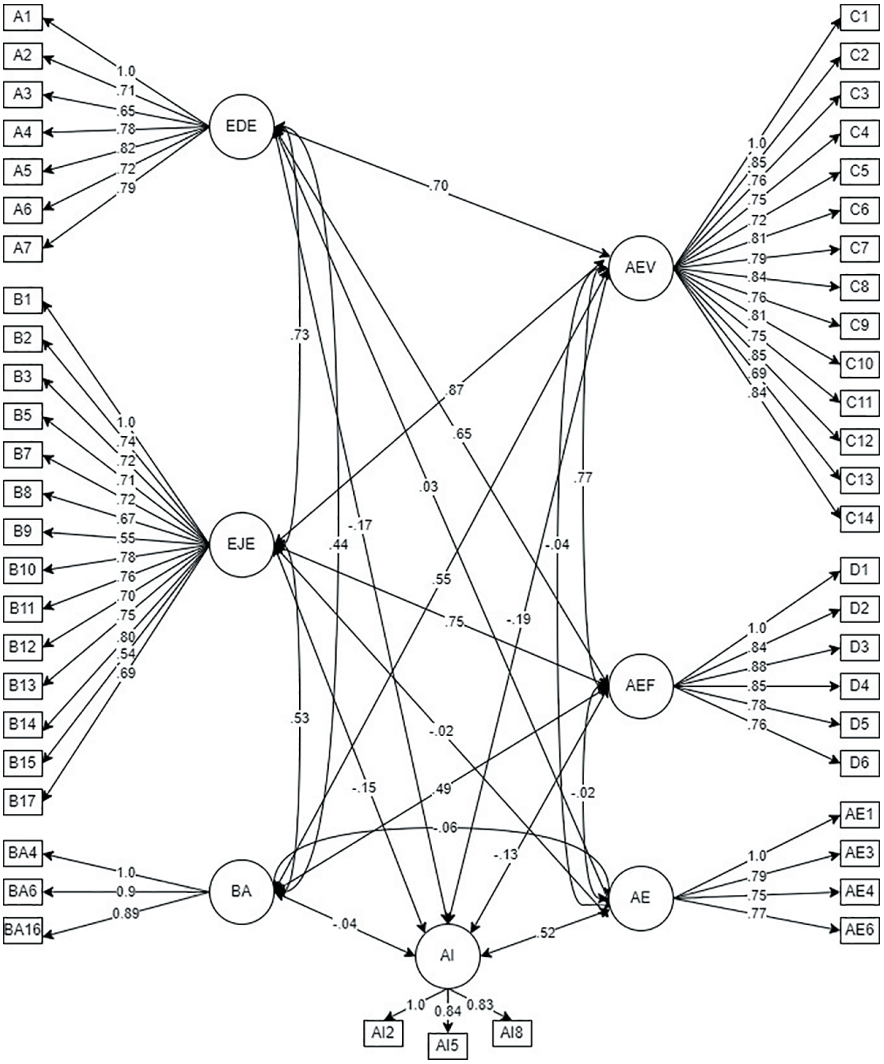
CIM	α	α*	AVE
Disposition to study scale (DSS)			
A1		.8	
A2		.8	
A3		.82	
A4	.82	.78	.62
A5		.78	
A6		.81	
A7		.8	
Execution scale (EXE)			
B1		.91	
B2		.9	
B3		.9	
B5		.91	
B7		.9	
B8		.91	
B9	.91	.91	.53
B10		.9	
B11		.9	
B12		.9	
B13		.9	
B14		.9	
B15		.91	
B17		.91	
Self-efficacy scale (SEF)			
D1		.88	
D2		.88	
D3		.88	
D4	.9	.88	.73
D5		.89	
D6		.89	
D7		.89	

CIM	α	A*	AVE
Self-reflection of study scale (SRE)			
C1		.94	
C2		.94	
C3		.94	
C4		.94	
C5		.94	
C6		.94	
C7	.95	.94	.65
C8		.94	
C9		.94	
C10		.94	
C11		.94	
C12		.94	
C13		.95	
C14		.94	
External causal attribution (EA)			
AE1		.82	
AE3		.81	
AE4	.84	.8	.69
AE6		.79	
AE7		.81	
Internal causal attribution (IA)			
AI2		.77	
AI5	.81	.71	.79
AI8		.76	
Seeking help scale (SH)			
BA4		.65	
BA6	.77	.66	.87
BA16		.76	

Note: CIM = coding of each item in the model; α = Cronbach's alpha; α* = Cronbach's alpha if the item is eliminated; AVE = average variance extracted.

Finally, Figure 1, shows that only the execution scale (EXE) has factor loadings of less than .6, corresponding to items B9 and B15. In all of the other scales, the loadings of the items are greater than .6. Regarding the correlations between the scales, the strongest correlations are between DSS, EXE, SRE, and SEF, with values of between .65 and .87, On the other hand, the weakest correlations are between the EA-SEF and EA-EXE scales, both with a value of -.02. The final version of the instrument can be downloaded from the supplementary material at the following link: https://figshare.com/s/42f3643b1116e1c899f2

FIGURE 1. Confirmatory factor analysis model.



3.2. Objective 2 results

The sample for comparison by sex comprised 499 students, as the 15 students who preferred not to state their sex were eliminated from it. The mean declared age was 11.91 (*SD* = 1.76). Regarding study level, 44 (8.8%) were in the third grade; 28 (5.6%), in the fourth grade; 100 (20.0%), in the fifth grade, 123 (24.6%), in the sixth grade; 81 (16.2%) in the seventh grade, and 123 (24.6%), in the eighth grade.

Table 4 presents the descriptive analysis of the data, which show that in no cases do the averages for the different SRL scales reach 6 points. The highest average is in the seeking help (SH) scale, where an average of 5.03 (*SD* = 1.66) can be seen for boys, while for girls the average is 5.13 (*SD* = 1.67). According to the interpretation of the instrument, this indicates suboptimal SRL levels in both male and female primary education students.

In contrast, only the *disposition to study strategies* (DSS) variable complied with the assumptions of normality and homoscedasticity required for the parametric test. In all other cases, the two assumptions reviewed were not fulfilled, and so the robust Yuen trimmed means test was applied.

TABLE 4. Comparison of study variables by sex.

	Male (*n* = 272)		**Female (*n* = 227)**				
Age	11.93 (*SD* = 1.71)		11.88 (*SD* = 1.82)				
	M (*SD*)	K–S Lilliefors	M (*SD*)	K-S Prueba de Lilliefors	Levene test	T-test/Yuen	ES
DSS	3.86 (1.50)	D = .039	4.05 (1.55)	D = .057	F (1,497) = 0.98	T (476.2) = -1.39	N/A
EXE	4.30 (1.38)	D = .047	4.48 (1.54)	D = .068*	F (1,497) = 6.09*	$T^{(r)}$ (244.7) = 1.72	N/A
SH	5.03 (1.66)	D = .117***	5.13 (1.67)	D = .131***	F (1,497) = 0.20	$T^{(r)}$ (292.6) = 0.95	N/A
SRE	4.32 (1.46)	D = .049	4.58 (1.58)	D = .077**	F (1,497) = 4.00*	$T^{(r)}$ (266.5) = 2.14*	0.15
SEF	4.37 (1.57)	D = .050	4.72 (1.71)	D = .091***	F (1,497) = 2.92	$T^{(r)}$ (274.1) = 2.72**	0.19
EA	2.69 (1.61)	D = .148***	2.77 (1.66)	D = .143***	F (1,497) = 0.24	$T^{(r)}$ (288) = 0.45	N/A
IA	3.67 (1.76)	D = .064**	3.72 (1.98)	D = .105***	F (1,497) = 7.18**	$T^{(r)}$ (254.4) = 0.12	N/A

Note: T(r) = Yuen test; N/A = not applicable; *M* = mean; *SD* = standard deviation; ES = effect size.

In relation to the differences for the study variables by sex, significant differences were detected in the *self-reflection of study* (SRE) variable (Yuen T (266.5) = 2.14, p = 0.03, ES =.15), where girls (M = 4.58, SD = 1.58) presented a higher level than boys (M = 4.32, SD = 1.46). Significant differences were also found for the *self-efficacy for disposition to study* variable (SEF) (Yuen T (274.1) = 2.72, p = 0.007, ES = .19), where girls (M = 4.72, SD = 1.71) displayed a higher level than men (M = 4.37, SD = 1.57).

3.3. Objective 3 results

To evaluate differences between the study variables by grade, we first tested compliance with the assumptions for the parametric one-way ANOVA test. The results of the Kolmogorov–Smirnov normality test with the Lilliefors modification were significant for the *seeking help* (SH) and *external causal attribution* (EA) variables (p <.001). So, for these two cases, it was not possible to assume normality in the distribution of their data. In all other cases, the test was not significant. Next, the assumption of homoscedasticity was evaluated using the Levene test, where for all of the variables the result was not significant (p >0.5) and so the homoscedasticity of the data in the groups can be assumed.

The parametric ANOVA test was used for variables that complied with the assumptions of normality and homoscedasticity, and in cases where neither assumption was fulfilled, the robust ANOVA repeated means test was performed.

The ANOVA test was significant for the *disposition to study strategies* (DSS) variable ($F_{(5, 508)}$ = 3.41, p <0.01, η^2 = 0.03). The post hoc Tukey comparison test was then performed, and identified a significant difference (p <0.01) for DSS among the levels of fourth grade (M = 4.6, SD = 1.48) and seventh grade (M = 3.48, SD = 1.53). There was also a significant difference for the *self-efficacy for disposition to study* (SEF) variable ($F_{(5, 508)}$ = 2.34, p <0.05, η^2 = 0.02). Next, the Tukey post hoc comparison test was performed, which identified a significant difference (p <0.05) for SEF among the levels of fourth (M = 5.10, SD = 1.48) and seventh grade (M = 4.11, SD = 1.78). The ANOVA test did not detect significant differences by grade in the EXE, SRE, and IA variables (see Table 5). Similarly, neither the ANOVA trimmed means test applied to the SH and EA variables detect any significant differences by grade.

Finally, it is important to note that the descriptive analysis of the data shows that the means of the different SRL scales in the different grades are lower than 6 points, with the highest mean (5.45) in the *seeking help* (SH) scale (SD = 1.36). According to the interpretation of the instrument, this indicates suboptimal SRL levels in primary students, regardless of grade.

4. Discussion

The findings relating to the first objective of this study made it possible to confirm the dimensional structure of

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TABLE 5. Comparison of study variables by grade (year).

Variable	3rd grade (n = 44)	4th grade (n = 29)	5th grade (n = 105)	6th grade (n = 127)	7th grade (n = 85)	8th grade (n = 124)	ANOVA/ANOVA trimmed means	η^2
DSS	4.24(1.50)	**4.67(1.48)**	3.98(1.6)	4.02(1.39)	**3.48(1.53)**	3.89(1.52)	F(5,508)= 3.41**	0.03
EXE	4.62(1.37)	4.87(1.35)	4.44(1.55)	4.42(1.29)	4.00(1.62)	4.35(1.42)	F(5,508)= 2.13	N/A
SH	5.42(1.43)	5.45(1.36)	5.16(1.76)	4.98(1.6)	4.88(1.81)	4.99(1.62)	$F^{(r)}$ (5,98.7)= 0.93	N/A
SRE	4.70(1.43)	4.77(1.62)	4.43(1.59)	4.53(1.45)	4.09(1.62)	4.39(1.44)	F(5,508)= 1.54	N/A
SEF	4.88(1.4)	**5.10(1.48)**	4.61(1.75)	4.54(1.52)	**4.11(1.78)**	4.47(1.64)	F(5,508)= 2.34*	0.02
EA	2.74(1.84)	2.75(1.81)	2.74(1.62)	2.94(1.71)	2.67(1.64)	2.62(1.51)	$F^{(r)}$ (5,96.7)= 0.36	N/A
IA	3.45(1.86)	3.59(2.18)	3.56(1.88)	3.77(1.74)	3.68(1.7)	3.92(2.02)	F(5,508)= 0.67	N/A

Note: η^2 = generalised eta (effect size); $F^{(r)}$: ANOVA trimmed means.

the self-regulation of learning phases instrument in primary education (SRL-PI-P). The results showed that it has an acceptable structure consisting of seven related factors with acceptable Cronbach's alpha and AVE index values in all cases. The scale consisted of 53 items, which makes using it with primary education students more practical. Balancing theoretical and practical questions when measuring SRL is still a challenge, especially in the case of large-scale studies with primary education students (Vandevelde et al., 2013). In this sense, the present study makes a valid and reliable study available for use with school children.

Regarding the findings relating to the second objective of this study, significant differences were confirmed in the SRE and SEF variable, where girls had higher averages. This is consistent with previous studies that have found that women have better self-regulation than men. For example, one study in a sample of 2027 fifth- and sixth-grade students from 44 primary schools (107 classes) in Belgium (50.4% male, 49.6% female) analysed the relationship between the SRL profile of students and their sex, finding that girls reported a more self-regulated profile (Heirweg et al., 2019). Another study in 283 secondary school students from Croatia found greater self-efficacy for self-regulated learning in girls (Putarek y Pavlin-Bernardić, 2019). Also in secondary education, a study of 403 students from ninth to twelfth grade in Chile revealed a significant effect of sex in the disposition to study phase of the SRL process in favour of girls (Sáez-Delgado et al., 2023). Another research also explored how much different SRL strategies varied by sex in 198 university students, finding that women more frequently used rehearsal, organisation, metacognition, and time, elaboration, and effort management skills (Bidjerano, 2005). Consequently, it can be argued that, at different educational levels (primary, secondary, and university), evidence has been found for female students using self-regulation learning strategies more than their male classmates.

In the case of the findings relating to the third objective of this study, there was evidence for significant differences in the DSS and SEF variables between the seventh grade and fourth grade levels, with the fourth grade displaying more frequent use of self-regulation strategies than students from higher years. Previous studies have shown similar findings; in some cases, SRL has stayed at the same level but in no case has it been found to increase as students progress to higher grades (years). For example, the results of a study evaluating differences by grade in secondary education, with the participation of 403 Chilean students, found no significant differences for any phases in the SRL process (Sáez-Delgado et al., 2023). Therefore, it is possible to conclude, on the basis of the results of this study and earlier research, that primary students' SRL does not spontaneously improve simply because they move from one academic

grade to the next. Although there seems to be a stagnation and even a drop-off in some SRL processes, it is important to consider the developmental perspective when analysing this result, that is to say, that as the students move on to the next term or to a higher year group (as they get older), they acquire a greater capacity to evaluate their real competence in place of a disproportionate view of their competence, unlike when they are younger (Guo, 2020). Furthermore, another possible explanation could be provided by cognitive social theory (Bandura, 1999), which insists that students can be influenced in their responses by their social surroundings (learning environment or school environment).

To interpret adequately the results of the present study, some limitations must be taken into account. Firstly, as the specialised literature suggests, it is important to consider the "limitations of generalisability", in other words, the results cannot be generalised to groups not represented in the study (Simons et al., 2017). This study focussed on public primary schools in the Biobío region of Chile, and so these results cannot be generalised to other educational levels, to private schools, or to other regions of Chile. A second limitation is the instruments used, which are of the self-report type, and so the responses could suffer from social-desirability bias (Solé-Ferre et al., 2019). Also relating to the limitations of the instrument, we should note possible gender biases, that is to say, measurement invariance, which determines the possible existence of invariance between the trait scores of the groups to determine whether these are comparable and have the same meaning; in in other words, whether the measurement evaluates the same trait in the same way in all groups (Reise et al., 1993). Therefore, taking this into account, until it is established that a measurement evaluates the same feature in two different groups, comparisons between them in the measurement are of uncertain significance (Putnick & Bornstein, 2016; Schmitt & Kuljanin, 2008). A third limitation relates to the sampling technique used in this study (non-probability convenience sampling), as the literature classifies this as a subjective sampling method, which has limited external validity. So, it suffers from sampling biases given that the participants in the sample are chosen according to their proximity to the researcher (Nielsen et al., 2017; Obilor, 2023). A fourth factor that could be seen as a limitation is the fact that the original instrument was applied to secondary education students and, in this study, it was adapted for use with primary education students. Although the lowest grades (first and second) were excluded to ensure sufficient reading skills and although validation tests were performed to identify possible difficulties with understanding the items, future studies should consider the specific characteristics of children of this educational level when attempting to administer the instrument. As a complex construct (SRL) is being measured, the students' stage and their level of development of reading skills must be taken into account, as these could lead

to difficulties in comprehension of the items (Borghi, 2020).

Future studies can minimise the limitations noted above. Firstly, they could consider a larger sample. It would also be desirable for studies to obtain data from sources other than self-report type instruments, such as observational methods, to give a more specific perspective on the self-regulation processes of the students. In addition, the findings of this study reflect a need to promote self-regulation to ensure its development, as without efforts to promote it, it remains the same and does not change over students' academic trajectories. As the results of a meta-analysis of SRL training programmes in primary education show, these efforts have proven to be effective (Dignath et al., 2008). The recommendations for educational interventions identified in the literature provide a framework for how to promote SRL directly through teaching strategies and indirectly by creating a learning environment that enables students to regulate their learning (Dignath & Veenman, 2021). Teachers have a central role on this point given that, in their professional practice, they can implement direct and indirect strategies to foster students' SRL skills by applying effective teaching methods and directing them towards techniques that improve their regulatory processes (Uka y Uka, 2020). In fact, teachers currently face the challenge of teaching students not only the essence of the disciplinary content of the different subjects, but also the process of learning itself. And so teaching students to use learning strategies effectively has become a popular instructional practice in primary schools that can be fulfilled by implementing SRL (De Smul et al., 2019). Consequently, it would be of interest for future studies to focus on training primary school teachers in practices for promoting SRL and on the variables that underlie the practices that promote SRL, identifying beliefs, knowledge, and skills that are closely related to teachers' implementation of self-regulatory learning (Sáez-Delgado et al., 2022).

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Authors' biographies

Fabiola Sáez-Delgado. Assistant professor in the Faculty of Education. Head of the Master's in Educational Science programme at the UCSC. Degree in Education, Master's in Education, and Doctorate in Psychology from the Universidad de Concepción, Chile. Her lines of research are cognitive-motivational variables in teaching and learning processes, mental health variables in educational communities, and socioemotional competences. She has specialised in systematic reviews of literature, psychometry, and analysis of predictive and explanatory models in education. Member of the "Society, education, and psychology" international research group (GISEP) and leader of the "Cognition, emotion, and disruptive technologies in education" research and innovation line. In the last five years, she has published more than 50 academic articles in high-impact journals and has led externally funded national and international projects.

https://orcid.org/0000-0002-7993-5356

Javier Mella-Norambuena. Part-time professor in the Department of Sciences of the Universidad Técnica Federico Santa María, Chile. Degree in Education and Master's in Health Psychology from the Universidad de Concepción, Chile. Doctoral candidate on the Education Doctorate programme at the Universidad Católica de la Santísima Concepción, Chile. His lines of research are cognitive-motivational variables in processes of teaching and learning and mental health variables in educational communities. He has specialised in systematic reviews of literature, research methodology, and quantitative data analysis using the SPSS, RStudio, and Python software programs. Member of the "society, education, and psychology" international research group (GISEP).

https://orcid.org/0000-0002-4288-142X

Marcela Bizama. Associate professor in the Faculty of Education of the Universidad Católica de la Santísima Concepción, Chile (UCSC). Qualified Teacher from the Universidad de Chile and Doctor in Education from the Universidad de Concepción (Stockholm University agreement). Her lines of research are cognition, learning, and development. She has specialised in the study of cognitive variables such as fluid intelligence, executive functions relating to attention and memory, creativity, and reading comprehension of various text types in different developmental stages. She has participated in various research projects, with national and international funding, and has numerous publications in a variety of indexed journals.

https://orcid.org/0000-0003-3515-4504

Joan Gatica. Candidate for a Doctorate in Education at the Universidad Católica de la Santísima Concepción, Chile. Master's in Management, Leadership, and Educational Policy from the Universidad de Concepción (Chile), and Master's in Quality School Management and Administration from the Universidad del Desarrollo (Chile). He researches

the impact of learning and playing chess and other board games on the acquisition and development of critical thinking, self-regulation of learning and metacognition. Head of primary and secondary schools for 16 years. School management advisor in schools and colleges in various regions of Chile. Promoter of projects to include chess in classrooms in Chilean schools.


https://orcid.org/0009-0002-9312-4012