DEVELOPMENT AND VALIDITY EVIDENCE OF THE SELF-REGULATION SCALE IN PLANNING AND TEACHING OF CLASSES IN HIGHER EDUCATION

CONSTRUÇÃO E EVIDÊNCIAS DE VALIDADE DA ESCALA DE AUTORREGULAÇÃO NO PLANEJAMENTO E MANEJO DE AULA NO ENSINO SUPERIOR

CONSTRUCCIÓN Y EVIDENCIA DE VALIDEZ DE LA ESCALA DE AUTORREGULACIÓN EN LA PLANIFICACIÓN Y GESTIÓN DE CLASES EN EDUCACIÓN SUPERIOR

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ABSTRACT: This research aimed at creating and validating a scale (CLEA-SR) to evaluate class planning and teaching self-regulation of individuals based on self-regulated learning. This is applied exploratory research with a quantitative approach involving 283 respondents from Brazil, with different graduate degrees. Experts' committees participated to find validity evidence. Data Analyses were descriptive analysis, validity evidence based on content, exploratory and confirmatory factor analyses, reliability and accuracy. Satisfactory values for reliability, a large correlation with the teaching self-efficacy scale, validity evidence based on content, and internal structures were found. CLEA-SR might be used as a pre-post evaluation instrument to structure faculty development programs in higher education institutions.

KEYWORDS: Evaluation. Teaching and learning. Higher education. Self-regulation. Social cognitive theory.

RESUMO: *Esta pesquisa criou e validou uma escala (AR-PLCO) para avaliar a autorregulação de indivíduos quanto ao planejamento e condução de aulas, baseando-se na aprendizagem autorregulada. Foi utilizada uma metodologia de pesquisa exploratória aplicada e de natureza quantitativa que envolveu 283 respondentes do Brasil, com diferentes níveis de pós-graduação. Juízes participaram visando encontrar evidências de validade. As análises de dados foram descritiva, evidência de validade baseada no conteúdo, análises fatoriais exploratórias e confirmatórias, confiabilidade e precisão. Foram encontrados valores satisfatórios para a confiabilidade, forte correlação com a escala de autoeficácia docente, evidência de validade baseada no conteúdo e estruturas internas. A escala AR-PLCO pode ser usada como um instrumento de pré-pós avaliação para estruturar programas de formação de professores do ensino superior.*

PALAVRAS-CHAVE: *Avaliação. Ensino e aprendizagem. Ensino superior. Autorregulação. Teoria social cognitiva.*

RESUMEN: *Esta investigación tuvo como objetivo crear y validar una escala (CLEA-SR) para evaluar la planificación de clases y la enseñanza de la autorregulación de los individuos a partir del aprendizaje autorregulado. Se trata de una investigación exploratoria aplicada con abordaje cuantitativo que involucró a 283 encuestados de Brasil, con diferentes graduaciones. Participaron comités de expertos para encontrar evidencias de validez. Los análisis de datos fueron descriptivos, evidencia de validez basada en el contenido, análisis factorial exploratorio y confirmatorio, confiabilidad y precisión. Se encontraron valores satisfactorios de confiabilidad, una gran correlación con la escala de autoeficacia docente, evidencia de validez basada en contenido y estructuras internas. CLEA-SR podría ser utilizado como un instrumento de evaluación pre-postgrado para estructurar programas de desarrollo docente en instituciones de educación superior.*

PALABRAS CLAVE: *Evaluación. Enseñanza y aprendizaje. Enseñanza superior. Autorregulación. Teoría social cognitiva.*

Introduction

Schools know that this century makes great demand on competent professionals stressing the relevance of teaching and learning. Universities have been attempting to update and improve their teaching and learning structure (Schmidt; Hansson, 2018). Europe has been concerned about education and continues to endeavor to find solutions. OECD (Organization for Economic Co-operation and Development) has developed the 'Supporting Quality Teaching in Higher Education' project aiming at high quality practices, and UNESCO emphasizes the need to improve quality education (Unesco, 2014). The German Federal Ministry of Education and Research (BMBF) and the federal states funded the 'Quality Pact for Teaching' program, which aimed at developing study conditions and improvement of teaching and advisory in higher education (Innovation, 2018).

The American Society of Civil Engineers (ASCE) issued 2 reports considering the necessity of teaching-learning improvement: "Civil Engineering Body of Knowledge for the 21st Century" (BOK), and the "Vision for Civil Engineering in 2025", in response to engineering teaching and learning improvement. The BOK report emphasized the relevance of higher education institutions, and faculty members is the first role models for civil engineers (Asce, 2008). The Vision report stressed the relevance of teamwork in different areas for a better design and in R&D projects, and that "life-long learning" will be the great difference in the world of 2025 to follow the knowledge transformations pace (Asce, 2007).

New curriculum guidelines for engineering (DCNs) in Brazil was launched in 2019, by Ministry of Education, The Brazilian Association of Engineering Education (ABENGE) and other agencies. They stated that undergraduate engineering courses should be aligned with the pedagogical plan, and keep permanent faculty development programs valuing teaching and interdisciplinary activities. Teachers should be more committed to graduating students' competences, and institutions should define key indicators for these programs evaluations and value teachers' work (Abenge, 2023).

The Graduate School is an articulation space for teaching and research, for science and technology development (Fernandes, 2020; Silveira; Nascimento, 2016). Universities academics have functions of researchers and teachers and to be a good teacher one has to be a good researcher. Promotion and salary depend entirely on research status. Researchers' activities increase their values and personal progress without considering their obligations with students establishing special suffering on young doctoral students (Kline; Kline, 1977). Teaching awards, better salaries, other benefits and other affirmations of the relevance of

teaching will not change that a research-intensive university will continue dependent on research production (Serow, 2000). As another example of teaching-research conflict, the participation in cooperation areas among BRICS countries has to meet some requirements. Proposals must be linked with public or private Higher Education with Graduate Schools recommended by CAPES having grades greater or equal to six (Thiengo; Bianchetti, 2019). Grades 6 and 7 are considered to have an excellence international standard (Eesc-Usp, 2022) and this is achieved by high level research projects.

A gap between what graduate schools offer today and what is required is complemented with the research and teaching conflict in Brazil and abroad (Bishop, 2018; England *et al*., 2021; Heekin, 2019; Karagiannis, 2009; Kline; Kline, 1977; Serow, 2000; Society, 2016; Thiengo; Bianchetti, 2019).

The research question was "How can an instrument be developed and validated, which can guide higher education individuals' self-regulation for classes planning and teaching?". The main objective was "Developing and validating a scale (CLEA-SR) to evaluate the Class Planning and Teaching Self-Regulation of individuals with different academic degrees in higher education". Specific Objectives were "Searching for CLEA-SR validity evidence based on Content and on Internal Structures"; "searching for CLEA-SR reliability"; "searching for CLEA-SR validity evidence based on teaching self-efficacy", and on other variables.

This article is part of the principal investigator's (PI) ongoing doctoral thesis in Civil Engineering faculty of The School of Civil Engineering, Architecture and Urban Design department, of Unicamp, Brazil.

Literature Review

Social cognitive theory states that most individuals' learning occurs within the social environment and witnessing others develop understanding, regulation, abilities, strategies, beliefs, and convictions (Schunk, 2012). One can find a large body of motivators within social cognitive theory. Self-efficacy (SE) is one of them. It is a construct related to individuals' self-evaluation of abilities to complete courses of actions and leads to their motivation, which can be seen in their efforts and behavior before obstacles. It mediates other factors as goal setting and outcome expectations. This resilience makes individuals more self-efficacious adapting their accomplishments and well-being (Bandura; Cervone, 2023). Aiming at knowing how students could acquire their own learning development, self-regulated learning (SRL), another construct of this theory appeared in mid-1980s. Self-regulated individuals behave in a proactive

manner rather than reacting before their teaching occurrences, demonstrating initiative, resilience and skills (Zimmerman, 2001). SRL has a crucial relevance of individuals' achievement to higher education (Jansen *et al.*, 2019). The cyclic SRL model of professor Zimmerman is the most known and used by scholars (Panadero, 2017). It is comprised of forethought, performance and self-reflection phases, where they are feedback for the following ones and promote the self-regulation (SR) cyclical nature (Panader *et al*., 2019; Zimmerman, 2005). The forethought phase paves the way aiming at the behavior development, where the establishment of goals and strategic designs occur. The performance phase is related to the task engagement, which requires efforts and alters concentration and action. The self-reflection phase occurs after the completion effort, which changes the individual's reaction to that practice (Cleary; Labuhn, 2013; Schunk; Usher, 2013; Zimmerman, 2005).

The development of the CLEA-SR scale is based on the SRL cyclic model of professor Zimmerman. A similar scale based on Professor Zimmerman's model has not been found in Brazil and abroad in databases as Web of Science, Scopus, and RIAEE archives, since 2019 until the present date. Keywords used for searches in English and the equivalent in Brazilian Portuguese were: self-regulation, self-regulated learning, cyclic self-regulated learning model, scale, inventory, questionnaire, instrument, and higher education.

Methodology

This is applied exploratory research (Stebbins, 2001) with a quantitative approach. APA, the American Psychological Association, AERA, the American Educational Research Association, and NCME, the National Council on Measurement in Education have updated the 2014 edition of "The Standards for Educational and Psychological Testing" (Aera-Apa-Ncme, 2014), which explains standards for scales creation and adaptation. These were used for this research. The method used in this research is as follows.

As for participants, a total of 283 respondents participated in this research, aged 23-78 (M = 40.5; SD = 12.9), and most female (55.47 %), having master (18%), master ongoing (18%), Ph.D. (31%), and Ph.D. ongoing (32%) degrees. They were from the region North (n = 2), the Northeast (n = 25), the South (n =28), the Southeast (n = 221) and the Center West (n =7) from Brazil. A total of 153 respondents (54%) were from state universities, 70 (25%) were from federal universities, and 60 (21%) were from private universities.

Respondents were from different knowledge areas groups: Medical (n=61), Engineering (n=81), Education (n=65) and others (n=76).

A total of 2 experts' committees were created to work on the original scale to verify its validity. One committee dealt with the analysis of CLEA-SR scale items, and it was comprised of five experts (four Ph.D., one master) with experience in teaching and in social cognitive theory constructs. The second committee dealt with the analysis of the CLEA-SR scale items semantics, and it was comprised of seven experts (one Ph.D., four Ph.D. ongoing, one master, one master ongoing) without any experience in social cognitive theory constructs.

As for instruments, these were a socio-demographic and respondents' characterization questionnaire, the final version of the CLEA-SR scale, created in this research, and the teaching self-efficacy scale.

CLEA-SR is a 1-factor scale with 32 items in its final version, which covers three phases of the SRL model, planning, execution and self-reflection. It is a 5-point Likert scale ranging from 1 to 5, strongly disagree to strongly agree respectively.

The teaching self-efficacy scale (TSES) is a 2-factor scale (teaching intentionality and class management) with 24 items. It is a 6-point Likert scale ranging from 1 to 6, strongly agree to strongly disagree respectively. This scale has been used in this research to corroborate the correlation with CLEA-SR, showing the importance of SR and SE in teaching and increasing CLEA-SR reliability. This scale had a transcultural adaptation to the Brazilian Portuguese language by Polydoro *et al.* (2004) from the teachers' sense of efficacy scale-TSES, named originally as Ohio State teacher efficacy scale-OSTES (Tschannen-Moran; Hoy, 2001).

As for procedures, the university ethics committee approved this research with the CAAE number 45318921.0.0000.8142, which meets laws 466 and 510 (Guerriero; Minayo, 2019) on confidentiality. The experts' committee for the analysis of CLEA-SR items had the responsibility to verify each of the 89 items of the original version of the CLEA-SR scale according to theoretical approach (cyclic self-regulated learning model). The experts' committee for the analysis of CLEA-SR items semantics had the responsibility to act as respondents replying all 32 items of the new version and to verity weather these items were clear and understandable. These two committees searched for validity evidence based on content.

The survey was through a Google form questionnaire with these research instruments and addressed to individuals in social media, knowing that the average time to answer it would be 25 minutes. Respondents could answer the questionnaire after confirming they were at least

18 years old, and they had master ongoing, master, Ph.D. ongoing, or Ph.D. degrees and agreeing with the Informed Consent Form. They knew they could interrupt their participation at any time with no harm to them. The data were collected from the end of 2021 until the beginning of 2022.

Data Analyses

Analyses were the following: descriptive data analyses of the sample; validity evidence analysis based on content; exploratory factor analysis (EFA) with weighted least squares (WLS) as an estimation method and confirmatory factor analysis (CFA) with diagonally weighted least squares (DWLS) as estimation method to observe the internal structure of the scale CLEA-SR; scale reliability and accuracy verifying alpha and omega coefficients; validity of the relation of CLEA-SR scale scores to the teaching self-efficacy scale scores using Pearson correlation; comparing SR mean differences with academic education degrees, with respondents' area groups using ANOVA, with courses within engineering area group, with basic and higher education teaching experience using T-test, and with respondents' age using Pearson's r correlation. All analyses used JASP 0.16.1.0 program. The application of RMSEA, CFI, and TLI has been reported by Xia and Yang (2019). According to Cohen (1992), differences effect sizes are interpreted as small ($d \geq 0.20$), as medium ($d \geq 0.50$), and as large ($d \geq 0.80$), and Pearson correlation "*r*" as small ($r >= 0.10$), as medium ($r >= 0.30$) and as large ($r > = 0.50$). Interpretation for fit indices as suggested by Marsh (2007) are: $CFI \geq 0.90$ (acceptable) and ≥ 0.95 (excellent), $TLI \geq 0.90$ (acceptable) and ≥ 0.95 (excellent), $RMSEA \leq 0.08$ (acceptable) and ≤ 0.05 (excellent).

Results

As for validity evidence on content, the experts' committee for the CLEA-SR scale items evaluated the original version of CLEA-SR (89 items) following the theoretical approach of the cyclic SRL model of Professor Zimmerman. After these analyses, the final version had 32 items. The experts' committee for the analysis of CLEA-SR scale items semantics evaluated the final version and reported that all items were clear and understandable and no change would be necessary. These two committees found the validity evidence based on content. Frame 1 shows the CLEA-SR scale final version.

Frame 1 – CLEA-SR Scale

Item
1. I consider the students' characteristics when I plan the class.
2. I consider the class duration for my planning.
3. I choose the most adequate strategies for the class teaching.
4. I evaluate whether I have previous knowledge needed for the class.
5. I reserve necessary time for the class planning.
6. I plan the material, which will be sent in advance to students.
7. I plan the details of the class.
8. I plan some questions to keep students' attention.
9. I plan the physical-virtual environment, which will be used for the class.
10. I try to predict unexpected events and create respective actions.
11. I feel capable of planning the class to achieve the established goals.
12. I consider this class as an opportunity for self-learning.
13. I present the class program to students in the beginning of the class.
14. I evaluate whether the class quality is according to what I planned.
15. I encourage students to ask questions during the class.
16. I evaluate whether the proposed activities draw attention from students.
17. Before class teaching difficulties, I tell myself that I will find a solution.
18. I use flowcharts, figures and images during class to aid my teaching.
19. I seek for help when necessary.
20. To overcome difficulties I search for similar moments when I was successful.
21. I try to monitor my actions, thoughts and motivation to guarantee the class quality.
22. I try to identify students' difficulties in understanding.
23. I make notes about successful and failed strategies and actions.
24. I share with students how much I value the class.
25. I check whether the class duration was according to the planned one.
26. I check whether the contents were presented according to the planned ones.
27. When the class is over, I ask students how I could improve it.
28. When the class is over, I evaluate the quality of internet, luminosity and noise.
29. When the class is over, I evaluate whether the strategies used in the class met the objectives.
30. I identify successes and failures during classes.
31. I feel satisfaction even before teaching difficulties.
32. I feel capable to make adaptations for the following classes according to the current class results.

Source: Created by the authors.

CLEA-SR scale had 32 items in its final version.

Concerning validity evidence based on internal structure, a 3-factor exploratory and confirmatory analysis was done. Having KMO (0.92) and Bartlett's ($X2 = 3936.00$; $df = 496.00$; $p < 0.001$), these seemed to indicate that three factors could be the best solution for the CLEA-SR scale. Although this seemed to be the best solution, fit indices obtained in this exploratory factor analysis showed that the 3-factor model was not adequate due to Chi-squared test ($X2 = 860.25$; $df = 403$; $p < 0.001$) and RMSEA = 0.06 and TLI = 0.84. Furthermore, table 1 shows 3-factor loadings.

Table 1 - CLEA-SR 3-Factor Loadings.

CLEA-SR Items	Factor Loadings		
	Factor 1	Factor 2	Factor 3
Planning			
12	**0.76**	-0.19	0.15
11	**0.68**	0.05	0.05
8	**0.65**	-0.15	-0.10
9	**0.59**	0.04	-0.05
7	**0.54**	0.12	-0.13
3	**0.52**	0.05	0.30
5	**0.48**	0.12	0.18
10	**0.48**	0.03	-0.22
1	**0.34**	0.10	0.15
6	**0.32**	0.20	0.13
4	0.30	0.01	**0.51**
2	0.29	0.17	**0.55**
Execution			
17	**0.72**	0.09	-0.02
15	**0.58**	0.03	0.20
21	**0.53**	0.14	-0.02
22	**0.51**	0.19	0.11
20	**0.49**	0.08	-0.04
16	**0.44**	0.18	0.19
13	**0.41**	0.28	-0.07
19	**0.38**	0.13	0.11
24	**0.36**	0.07	-0.26
18	**0.34**	0.17	0.24
14	**0.31**	**0.34**	0.04
23	0.22	0.07	-0.26
Self-Reflection			
32	0.56	0.13	-0.03
31	**0.54**	**0.39**	-0.29
27	0.25	**0.47**	-0.29
26	0.16	**0.48**	**0.37**
25	-0.09	**0.60**	**0.35**
28	0.07	**0.67**	-0.18
30	0.06	**0.64**	0.11
29	0.02	**0.80**	0.01

Source: Created by the authors.

One can see that those factor loadings were not coherent with the CLEA-SR theoretical structure.

A 3-factor confirmatory analysis was done for all items from CLEA-SR phases. The analysis had good fit indices (X2 = 450.52, df = 461; p = 0.63; CFI = 1; TLI = 1; RMSEA = 0). Factor loadings were above 0.30 with a mean of 0.56 for planning, 0.58 for execution, and 0.60 for self-reflection. Although those results seemed to be good, the factor correlations were large. Factor 1 with factor 2, factor 1 with factor 3, and factor 2 with factor 3 had correlations of 0.89, 0.75 and 0.91 respectively, indicating that these factors evaluated similar things.

Knowing that the 3-factor model was not the best solution, the 1-factor analysis was done. It resulted in the best solution for this scale, showing a more parsimonious solution for the CLEA-SR structure. The analysis had good fit indices (X2 = 517.57; df = 464; p = 0.04; CFI = 1; TLI = 1; RMSEA= 0.020). Table 2 shows 1-factor loadings.

Table 2 – 1-factor Analysis Factor Loadings with all CLEA-SR Items Numbers.

Theoretical Factor	Planning		Execution		Self-Reflection	
CLEA-SR Items Numbers & Factor Loadings	1	0.42	13	0.43	25	0.46
	2	0.47	14	0.59	26	0.62
	3	0.57	15	0.63	27	0.47
	4	0.44	16	0.62	28	0.53
	5	0.52	17	0.71	29	0.64
	6	0.48	18	0.48	30	0.59
	7	0.50	19	0.53	31	0.50
	8	0.63	20	0.52	32	0.62
	9	0.65	21	0.66		
	10	0.50	22	0.66		
	11	0.53	23	0.51		
	12	0.57	24	0.49		

Source: Created by the authors.

Those are good values, above 0.40, with a mean of 0.55.

Table 3 shows the CLEA-SR scale reliability.

Table 3 - CLEA-SR Scale Reliability.

Estimate	McDonald's ω	Cronbach's α
Point estimate	0.93	0.94
95% CI lower bound	0.92	0.92
95% CI upper bound	0.94	0.95

Source: Created by the authors.

Those are good omega and alpha values for CLEA-SR scale reliability

The teaching self-efficacy scale reliability had omega equals to 0.94 (teaching intentionality) and 0.89 (class management).

Table 4 shows the correlation between CLEA-SR and teaching self-efficacy.

Table 4 - Correlation between CLEA-SR and Teaching Self-Efficacy Scale.

Variable	CLEA-SR Scale	Teaching Self-Efficacy Scale (Factors)	
		Teaching_intentionality	Class_management
1. Self_regulation	—		
2. Teaching_intentionality	0.673[a]	—	
3. Class_management	0.635[a]	0.909[a]	—

Notes: [a]$p < .001$; p = statistical significance.
Source: Created by the authors.

A large correlation (r=0.673; r=0.635) was found using Pearson's r analysis.

Table 5 shows ANOVA and Post-hoc analysis to compare self-regulation (SR) mean differences with academic education degrees.

Table 5 - Self-Regulation Related to Academic Education Degrees.

Acad. Educ.	*Mean*	*SD*	*n*	Comparison	p_{Tukey}	*d*	*F*	*p*
Master	4.22	0.53	51	Master_Ongoing	0.53	0.27	2.007	0.113
				PhD	0.98	0.07		
Master_Ongoing	4.08	0.57	51	PhD_Ongoing	1.00	0.04		
				PhD	0.22	0.34		
PhD	4.25	0.45	88	PhD_Ongoing	0.19	0.30		
PhD_Ongoing	4.10	0.55	93	Master	0.57	0.23		

Notes: Acad. Educ. = Academic Education; *SD* = standard deviation; *n* = number of respondents; *ptukey* = statistical significance of the Tukey post hoc test; *d* = Cohen's d effect size; *F* = ANOVA test statistic; *p* = statistical significance.
Source: Created by the authors.

The master had a higher score than the master ongoing, and a higher score than the Ph.D. ongoing, all with a small to medium effect size of d=0.267, and d=0.226 respectively. The PhD had a higher score than the master ongoing, and a higher score than the Ph.D. ongoing, all with a small to medium effect size of d=0.298, and d=0.339 respectively.

Table 6 shows respondents' areas of study divided into four groups.

Table 6 - Knowledge Area Groups.

Knowledge Area Groups	Qtd.
Engineering	81
Medical	61
Education	65
Others	76

Notes: Qtd. = quantity.
Source: Created by the authors.

Engineering group had civil engineering, architecture, sanitary engineering, and electrical engineering; medical group had medicine, nutrition, dentistry, pharmacy, nursing, food technology, biological sciences, and physical education; education group had science teaching, educational psychology, special education, and developmental disorders; and others group had biochemistry, mathematics, physics, accounting, law, geography, and history.

Table 7 shows the ANOVA analysis to compare SR mean differences among groups of respondents' areas of study.

Table 7 - ANOVA and Post-hoc: CLEA-SR Relation to Respondents' Areas Groups.

Area Groups	*Mean*	*SD*	*n*	Comparison	p_{Tukey}	*d*	*F*	*p*
Medical	4.1	0.56	61	Engineering	0.53	0.23	2.74	0.04
Engineering	4.22	0.5	81	Education	0.86	0.13		
				Others	0.25	0.3		
Others	4.06	0.49	76	Medical	0.98	0.07		
Education	4.29	0.53	65	Medical	0.19	0.36		
				Others	0.06	0.43		

Notes: *SD* = standard deviation; *n* = number of respondents; *ptukey* = statistical significance of the Tukey post hoc test; *d* = Cohen's d effect size; *F* = ANOVA test statistic; *p* = statistical significance. Source: Created by the authors.

Education group had the highest score (4.29) and the others group, the lowest (4.06). The education group, with a small to medium effect size had a higher score than medical group (d=0.36) and others group (d=0.43). The engineering group, with a small to medium effect size had higher score than others group (d=0.3) and with a small effect size had a higher score than medical group (d=0.23).

Table 8 can show the engineering group divided into group A and group B.

Table 8 - Respondents' Engineering Group.

A/B	Area	Qtd.
A	Architecture	2
	Architecture, Technology and City	1
	Sanitary Engineering	2
	Environmental Engineering	1
	Civil Engineering	14
	Civil Engineering - Water, Energy and Environmental Resources	1
	Urban Engineering	1
	Urban Planning - Architecture	1
B	Engineering[a]	52
	Computing Engineering	1
	Electrical Engineering	2
	Quality Engineering	1
	Chemistry Engineering	2

Source: Created by the authors.

Group A had 23 respondents and group B, 58 respondents, to separate civil engineering courses and alike from the others.

Table 9 shows a comparison between both groups.

Table 9 - Comparison between Group A and Group B.

	Group A		Group B		*t*	*p*	*d*
	M	*SD*	*M*	*SD*			
Self-Regulation	4.24	0.45	4.21	0.53	-0.28	0.78	0.07

Notes: *M* = mean; *SD* = standard deviation; *t* = Student test t statistic; *p* = statistical significance; *d* = Cohen's d effect size.
Source: Created by the authors.

No significant difference was found between both groups.

Table 10 shows SR mean differences between respondents with and without teaching experience in basic and higher education.

Table 10 - CLEA-SR Relation to Teaching Experience: T-test Analysis.

Teaching Experience		*M (SR)*	*SD*	*t*	*p*	*d*
Basic Education	NO	4.16	0.5	-0.266	0.79	0.035
	YES	4.17	0.6			
HE	NO	4.03	0.54	-3,782	< .001	0.453
	YES	4.27	0.48			

Notes: SR: Self-Regulation; *M* = mean; *SD* = standard deviation; *t* = Student test t statistic; *p* = statistical significance; *d* = Cohen's d effect size; HE = Higher Education.
Source: Created by the authors.

For those with basic education teaching experience compared with those with no experience, no difference was found, with effect size close to null (d=0.035). Considering higher education teaching experience, differences were found between those with and without teaching experience, with effect size close to medium (d=0.453).

Table 11 shows the CLEA-SR Relation to Respondents' Age.

Table 11 - CLEA-SR Relation to Respondents' Age - Pearson's correlation.

Variable	Age	Self-Regulation
1. Age	1	
2. self-regulation	0.188[a]	1

Notes: [a]*p* < .01; *p* = statistical significance.
Source: Created by the authors.

A small to medium and significant Pearson's correlation (r=0.188) between respondents' age and SR was found.

Discussion

This research created one instrument (CLEA-SR) aiming at teaching and learning improvement in higher education and meets the requirements of reports BOK and Vision from ASCE-The American Society of Civil Engineers (Asce, 2007; 2008) and new curriculum guidelines for engineering (DCNs) from Brazil (Abenge, 2023).

The validity evidence based on content was found by the experts' committee for the analysis of original CLEA-SR scale items, and by the committee for the analysis of the CLEA-SR scale final version items semantics. Validity evidence based on Internal Structure was found with satisfactory fit indices and loading factors explaining the 1-factor structure scale as the best solution, and scale reliability alpha and omega with satisfactory values.

Other pieces of validity evidence on CLEA-SR relation to other variables were found. Using Pearson's r analysis, a large correlation was found between the CLEA-SR scale and the teaching self-efficacy scale (TSES), the Brazilian adapted version. The American TSES original version is a well- known scale and has been used in many research projects all over the world (Amirian *et al*., 2023; Deng *et al*., 2022; Kiran, 2022; Pisanti; Soraci; Schwarzer, 2023; Toe; Longaretti, 2022).

Respondents with the master degree had a higher score than the master ongoing and the Ph.D. ongoing with a small/medium effect size; the Ph.D. had a higher score than the master ongoing and the Ph.D. ongoing, with a medium effect size. This might suggest that individuals with master and Ph.D. degrees are not influenced by the higher education culture anymore with many demands as research projects, article publishing, and participation in congresses. Research developed by Evans *et al*. (2018) showed that graduate students in the USA were more depressive and anxious than the general population. Another research developed by Schmidt and Hansson (2018) reported problems with doctoral students, which might become more serious today when individuals in the whole world suffer with the COVID-19 pandemic, where classroom environments had severe restrictions, which led to "emergency remote teaching (ERT)". That made individuals more anxious and the higher the anxiety the lower the self-efficacy is (Han; Vaculíková; Juklová, 2022).

Having the education group, the highest score (4.29) was expected for their regular studies on individuals' behavior and educational psychology. It was not expected that the medical group had a low score (4.1). This might have happened for this group was comprised of other courses besides medicine. Medicine courses are usually concerned about teaching and learning. The concept of Program Based Learning (PBL) was pioneered in the School of

Medicine at McMaster in the 1960s, as a new approach to medical education (McMaster, 2023). The concept of Experience Based Learning (ExBL), aiming at twenty-first century teaching improvement is also common in this area (Dornan *et al*., 2019).

When dividing the engineering group into group A with civil engineering and alike (as architecture and sanitary engineering), and into group B with other courses as computing engineering and electrical engineering, no significant difference was found between them. A limitation here might be the case that most of respondents who reported engineering course did not specify which engineering.

A small to medium and significant correlation was found between respondents' age and SR, showing that the higher the age the higher the SR. Kizilcec; Pérez-Sanagustín and Maldonado (2017) discovered that older students were more strategic when setting their goals in MOOCs, involving students from around the world, which contradicts what Li (2019) found in a study involving Latin American students with courses in Spanish. Furthermore, a gap can be found in literature about relations between SR and age.

The following lines show some studies from literature involving self-regulation and self-efficacy, which help corroborate this research findings.

Mickwitz and Suojala (2020) developed a quantitative-qualitative approach study and reported the relevance of self-regulatory strategies and self-efficacy beliefs. Truong (2022) found that English grammar self-efficacy had a significant correlation on self-regulated learning (SRL) strategies in grammar learning. Russel and colleagues from a research-intensive Australian university developed a study (Russell *et al*., 2022) aiming at examining 10 elected educators' teaching practices, and experience in their teaching to promote learner's SRL in different courses. Educators spoke about relevance of their actions to co-regulating students through implicit strategies as: task design, instruction, assessment, feedback and modeling strategies. Researchers from Australia and Spain (Broadbent *et al*., 2022) proved that the SRL model can be usually tailored for different subjects and courses and that social cognitive theory operates as a strong theoretical framework for the creation of instruments to evaluate SR. Good results were found when interventions were made with high school teachers involving the knowledge of SRL and SE as part of their professional development (Cleary *et al*., 2022).

Schunk and Pajares (2009) emphasized the magnitude of school environments for increasing a high sense of efficacy, or possibly weakening it if encouragement is not granted. It is relevant to create an environment and culture, which encourage students do take risks. This

should be aligned with teaching processes to foster students. Educator's SR plays an important role in processes to foster students' SR.

Conclusion

This study investigated psychometric properties of the CLEA-SR scale. Results indicated that the scale created to measure the self-regulation in planning and teaching of classes in higher education has pieces of validity evidence and is reliable. Furthermore, it has relations to variables as teaching self-efficacy, academic education degrees, knowledge areas, basic and higher education teaching experience, and respondents' age, which improve its validity.

CLEA-SR scale might be used as a pre-post evaluation instrument to structure faculty development programs in higher education institutions. It might identify teachers' weaknesses and strengths in planning, teaching and self-reflection about their classes. This might bring continuous upgrade to programs, which promote the enhancement of teaching and learning culture and feedback to teachers about self-regulatory strategies concerning their classes. These should aim at current professors and graduate students who will be teaching in the future. Being self-regulated in their classes planning and teaching, teachers might be able to foster self-regulation in their students and be role models for them. Other scales as teaching self-efficacy (TSES) might be used as support tools.

We have been living in a globalized world with a high integration in communications, and vast amounts of new and upgraded video conference and other resources have been available. People linked to education not only have to deal with this avalanche of resources to be learned, but also with the relationships among students, teachers, researchers, and other stakeholders. Hopefully future teachers will be better prepared to contribute for a healthier higher education. This study together with others from literature corroborate that the self-regulated learning model can be extensively designed for different academic subjects and courses.

Schools should invest in research projects as: using CLEA-SR scale to evaluate interventions effects of faculty development programs; broadening validity evidence studies to include other teachers and graduate students' profiles; comparing research results with faculty programs from other institutions.

This study makes contribution to research and theory and it sheds light on how to improve teachers' self-regulation concerning their classes planning and teaching in different courses in higher education and other educational programs.

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Respondent data: https://doi.org/10.25824/redu/IKMQSW;
Escala TSES: https://doi.org/10.25824/redu/ZXV00X
CLEA-SR Factor Loadings-3-Factor-Free Translation: https://doi.org/10.25824/redu/A8EDZW
JASP Configuration: https://doi.org/10.25824/redu/NFKDXV
Original scale items sent to the judges: https://doi.org/10.25824/redu/SJRGZI.

Authors' contributions: José Carlos Redaelli: participated in the design of the methodology; performed data collection, data tabulation, data analysis, description and interpretation of data; and writing of the text. Soely Aparecida Jorge Polydoro: supervised the study and methodology, design and made critical reviews. Tiago Zenker Gireli: coordinated and supervised the study, made the final revision and approved the manuscript.

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