# Development and Validation of a Questionnaire for Self-regulated Learning in Blended or Technology-mediated Learning Environments in Higher Education

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**Abstract**
Higher education has undergone significant transformations with the incorporation of blended learning. Self-regulated learning has been identified as a crucial factor for academic success in this context. However, the measurement of self-regulated learning in blended learning environments remains limited. This study aims to develop and validate a questionnaire to assess self-regulated learning in Chilean university students participating in blended learning environments. An instrumental study was conducted with a sample of 1,147 university students from an institution in southern Chile. A sequential methodological design was used to validate the dimensions of the questionnaire. The sample was randomly divided into two groups, 556 students for exploratory factor analyses and 591 students for confirmatory factor analyses. The final questionnaire comprises 71 items distributed in three main dimensions: Planning, Execution and Assessment, with specific sub-dimensions for each. The psychometric analysis revealed adequate validity and reliability indices, confirming the factorial structure of the questionnaire and its ability to measure self-regulated learning in blended learning contexts.

*Keywords:* Self-regulated learning; blended learning; higher education; psychometric validation

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# Introduction

The experience of teaching and learning during emergency remote education (ERE) highlighted the importance of designing flexible and versatile learning spaces, allowing teachers and university authorities to reflect on integrating virtual tools with traditional face-to-face education (Gómez, 2020; Kuklinski & Cobo, 2020). The international trend is to develop practices for high-quality virtual teaching (Zhu & Liu, 2020), with blended learning (BL) emerging as a leading model (Cobo-Rendón et al., 2022; Gqibani, 2022; Kamali & Bagheri-Nesami, 2022; Lobos et al., 2023a). BL enables the delivery of content in a virtual modality while allowing face-to-face sessions for active learning (Murphy, 2020; Rasheed et al., 2020). Nevertheless, researchers (Chiu & Hinds, 2022; Kamali & Bagheri-Nesami, 2022; Lobos et al., 2023b; Lobos et al. 2023c) have reported that students face new challenges with BL, such as distraction, lack of direct social interaction, demand for greater autonomy, and better management of time and educational space. Self-regulated students would be better equipped to overcome these challenges since they could apply strategies to stay focused, seek help, and make timely adjustments in their studies. However, little is known about self-regulated learning (SRL) in BL contexts, since not only did learning environments change, but so did the strategies students use to self-regulate their learning. Therefore, SRL had evolved in form and content, rendering traditional instruments insufficient to capture its current expression. This study adopted an instrumental design, expecting to develop a questionnaire that measures SRL in BL university educational contexts.

# Literature Review

### *Blended Learning in Higher Education*

BL is an educational modality that combines face-to-face and virtual education. Unlike traditional face-to-face learning, which doesn't involve online academic activities, and virtual learning, which doesn't include face-to-face academic activities, BL combines both with the aim of leveraging the advantages of the strategies, technologies, and pedagogical activities of both modalities for the benefit of student learning (Bartolomé Pina, 2004; Hrastinski, 2019). Thus, BL is considered an effective teaching method since it provides flexible, timely, and continuous learning (Brown, 2016). BL's virtual component consists of virtual classrooms, enabling asynchronous learning through diverse innovative resources (Martínez & Jiménez, 2020), and emphasizes student independence, critical thinking, and collaborative work through meaningful activities (Martínez & Jiménez, 2020; Prasad et al., 2013). BL has been proven to be as effective as, or more effective than, traditional face-to-face teaching (Besser et al., 2022; Broadbent, 2017; Vuttanon et al., 2021).

The most relevant benefits of BL in higher education are: (a) increased accessibility for students who would otherwise struggle to attend a traditional university due to geographical or mobility barriers (Ibrahem Qetesh et al., 2020; Megahed & Ghoneim, 2022); (b) integrating both face-to-face and online teaching methods, providing a richer educational experience (Vuttanon et al., 2021); (c) online learning platforms can offer adaptive materials, allowing students to progress at their own pace (Broadbent, 2017; Guppy et al., 2022); (d) digital tools facilitate collaboration and communication between students and teachers beyond physical limitations (Pollock, 2022); (e) face-to-face sessions can focus on activities that benefit from direct interaction, such as debates, labs, and group work, while lectures and theoretical content can be

covered online (Cobo-Rendón et al., 2022); and (f) maintaining an online learning infrastructure ensures that students can continue their studies without significant interruptions, regardless of external circumstances (Besser et al., 2022). Also, the use of digital tools and platforms in BL higher education better prepares students for an increasingly digitized work environment, as it promotes skills such as self-management, digital communication, and autonomous problem-solving.

Currently, higher education is moving towards a BL model because it grants greater effectiveness and efficiency to educational processes and aligns with the needs and expectations of students and the demands of the contemporary world (Järvelä et al., 2021; Molenaar, 2022). In the context of Chilean higher education, Law No. 21,091 recognizes BL, understood as the combination of face-to-face and virtual classes, for undergraduate programs (Ministry of Education of Chile, 2018). Therefore, Chilean higher education institutions offer fully face-to-face modalities without online tools or activities; fully virtual modalities with asynchronous and/or synchronous online activities; a blended modality where some courses are taught entirely face-to-face and others entirely virtually; and a blended modality where classes are entirely face-to-face but are supplemented with asynchronous online activities and resources.

### *Self-Regulated Learning (SRL) and Higher Education*

SRL is understood as an active process through which students direct, monitor, and reflect on their learning, adjusting their strategies according to personal goals and contextual demands (Zimmerman, 2000). This ability involves cognitive, motivational, emotional, and behavioral components that influence academic performance and autonomy (Ganda & Boruchovitch, 2018).

Three theoretical models have shaped the conceptualization of SRL: Zimmerman (1998) proposed a three-phase model (forethought, performance, and self-reflection); Winne and Hadwin (1998) described four stages (task definition, goal setting and planning, enactment, and adaptation); and Pintrich (2000) outlined a four-phase model (planning, monitoring, control, and reflection). While Zimmerman and Winne and Hadwin primarily focus on cognitive processes, Pintrich highlights the emotional aspects involved in learning regulation (Ganda & Boruchovitch, 2018; Trías & Huertas, 2020). Across all models, learners are seen as proactive agents who strategically engage with their learning goals while mediating between their individual characteristics and the learning environment.

Empirical evidence supports the value of SRL in higher education. Students who develop SRL tend to achieve higher academic outcomes, demonstrate greater engagement in learning tasks, and exhibit positive emotions toward academic experiences. Furthermore, they report stronger academic self-efficacy, which enhances their confidence in overcoming academic challenges (Alegre, 2014; Gómez Martínez & Romero Medina, 2019; Marcelo & Rijo, 2019; Xu et al., 2022). Research also indicates that SRL increases course completion rates, strengthens problem-solving and conflict resolution skills, promotes responsibility and independence, and facilitates adaptation to university life (Broadbent, 2017; Cerezo et al., 2020; Jin et al., 2023). Moreover, self-regulated students positively impact teaching by reducing the need for constant supervision, allowing instructors to engage in more meaningful pedagogical strategies (Cerezo et al., 2020; Lobos et al., 2023a). These students typically manage their time effectively, set clear

goals, use strategic learning methods, and demonstrate high levels of autonomy and motivation. In contrast, students with low SRL skills are at risk of academic failure, delayed graduation, and dropping out (Advíncula & Aguirre, 2021).

The hybrid nature of BL requires learners to exercise greater control over their schedules, maintain focus in the face of distractions, and regulate their engagement with academic tasks without continuous teacher presence. However, research reveals that many students face difficulties with SRL in virtual or hybrid environments, particularly in planning, time estimation, and managing distractions such as social media, challenges that are especially pronounced among disadvantaged student populations (Hodges et al., 2020; Varas-Meza et al., 2020; Viberg et al., 2018). Along the same lines, Barnard et al. (2009) pointed out that, due to the characteristics of online and blended learning such as high levels of autonomy and the lack of external structure, it is essential to have specific instruments that assess self-regulatory skills in these contexts.

### *Measuring SRL in BL*

The measurement of SRL has evolved with diverse instruments shaped by new findings. Hernández Barrios and Camargo Uribe (2017) reviewed SRL measurement in Ibero-American higher education, identifying 12 instruments: 4 unidimensional, 3 addressing specific facets, and 1 focused on virtual education. León-Ron et al. (2020) reviewed SRL instruments across educational levels (2009–2019), finding 31. They noted the Motivated Strategies for Learning Questionnaire (MSLQ) as the most used and highlighted limited research in Central and South America. Likewise, Roth et al. (2016) conducted a systematic review of self-report instruments used in higher education, identifying a predominance of questionnaires based on quantitative offline standards and highlighting the lack of instruments that assess emotional and motivational regulation. They also noted a growing trend toward course- or domain-specific instruments rather than general ones, which is particularly relevant for BL contexts. Maldonado-Mahauad et al. (2020) identified SRL instruments (1991–2016) for MOOCs, finding most were created in the 1990s for face-to-face contexts. Virtual components in these instruments fail to address current technology's nuances. Instruments for virtual higher education include Learning and Study Strategies Inventory (LASSI), Online Strategies for Learning Questionnaire (OSLQ), and Self-regulated Online Learning Questionnaire (SOL-Q). LASSI and OSLQ were designed in the 1990s, while SOL-Q (Jansen et al., 2017) partially addresses SRL.

A review of Web of Science (WOS), Scopus (2018–2023) and SciELO found one relevant instrument: the Self-Regulation Questionnaire for Online Learning (SRL-O), by Broadbent et al. (2023), based on face-to-face SRL instruments. It focuses on the planning stage but lacks coverage of other SRL stages in Zimmerman's theory.

In summary, although existing instruments have contributed to the understanding of SRL, they present limitations in addressing BL environments' demands. The transformations experienced in education following the COVID-19 pandemic marked a turning point in the ways teaching and learning are carried out, altering the ways in which students regulate their own learning, making conventional instruments inadequate for capturing the present-day characteristics of SRL. Therefore, this study aims to develop an instrument for measuring SRL in BL university contexts. Unlike traditional questionnaires (e.g., MSLQ, LASSI, OSLQ), which were originally designed for face-to-face contexts or for those with partial technological

mediation, this instrument explicitly integrates the phases proposed by Zimmerman (2000) and the categories from Winne and Hadwin (1998), adapting them to the challenges of BL. The construction of items was not limited to replicating classical definitions but rather drew on a qualitative study with students in hybrid environments, which allows for the incorporation of emerging behaviors related to the use of digital resources, management of the virtual study environment, preparation of online materials, monitoring through external parameters (such as comparisons with peers and teacher feedback), and motivational reactions specific to sustaining effort without the physical structure. These dimensions, which are rarely considered in previous instruments, justified the need for a new questionnaire that more accurately captures SRL strategies in BL modalities.

# Method

The instrumental study design (Ato et al., 2013) was employed to design and validate questionnaires or measurement scales, thus meeting the objective of evaluating the psychometric properties of the SRL questionnaire among Chilean university students in BL. To validate the dimensions of the questionnaire, a sequential methodological design was used, beginning with an in-depth qualitative phase to gather insights for the quantitative phase (Creswell & Creswell, 2023).

### *Participants*

The responses of 1,147 students (596 women) from a university in southern Chile were examined, which corresponds to 4.3% of the 26,644 students invited to the study. The sample included students from first to fifth year, the vast majority (89.45%) being first-year students. The participants ranged from 17 to 37 years, with a mean age of 18.9 (SD = 2.2). The sample included students of the following areas of study: Administration and Commerce (7.0%), Agriculture and Marine Sciences (3.4%), Art and Architecture (4.3%), Natural Sciences and Mathematics (11.4%), Social and Behavioral Sciences (7.3%), Law (3.7%), Education (12.1%), Humanities (2.7%), Engineering and Technology (29.7%), and Health (18.4%). The selection of participants was carried out through a non-probabilistic convenience sampling. The participants' learning environment consisted of subjects with a BL modality, which consisted of face-to-face classes with complementary asynchronous online academic activities hosted on the university's CANVAS learning management system.

### *Instrument*

Questionnaire for SRL in BL

The initial version of the instrument was designed with a 5-point Likert scale, where 1 is "never" and 5 is "always." To construct the instrument, the authors relied on León-Ron et al. (2020)'s findings, and on a literature review carried out in the Wos, Scopus, and SciELO databases to search for articles published after 2019 that reported SRL instruments in virtual contexts. The SRL-O (Broadbent et al., 2023) was identified, which had items adapted from SRL instruments for face-to-face contexts for online education. Given that, a qualitative study was conducted to collect information on SRL from students who have experienced studying in a BL university context (Lobos et al., 2024), resulting in an instrument with 152 items divided into three dimensions: Planning (64), Execution (53), and Assessment (37). For each of these dimensions, the items were organized into subdimensions (Appendix 1).

Content validity was studied through expert judgment, selecting five professionals under three criteria: (a) Master's and/or Doctorate degree, considering that this level of education guarantees an advanced command of the theoretical and methodological frameworks, (b) scientific production linked to SRL, to ensure up-to-date and specialized knowledge, and (c) experience in e-learning or BL education, as the instrument was designed for these contexts, requiring validation sensitive to their pedagogical and technological aspects. The level of agreement among the experts, according to Aiken's V coefficient (Merino-Soto, 2018), was 0.92. As a result, the number of items was reduced from 152 to 84 (Table 1). This decrease is primarily explained by the presence of items that intentionally addressed the same content using different formulations. This strategy was adopted to evaluate the clarity and effectiveness of various wordings, allowing the judges to select the versions with clearer and more precise wording. Additionally, items that did not demonstrate high relevance or pertinence to their assigned dimension were discarded. Within the Planning dimension, the subdimensions *Preparation of virtual learning materials* and *Study environment preparation* were merged, based on the judges' assessment that virtual materials do not differ substantially from those used in in-person contexts.

**Table 1**

*Distribution of SRL Questionnaire Items Following Expert Judgment Process*

| Dimensions | Sub-dimensions | Initial items | Final items | Elimination criteria |
|---|---|---|---|---|
| Planning (from 64 to 37) | Time planning | 8 | 6 | 1 (C); 1 (R) |
| | Study environment preparation | 8 | 5 | 2 (C); 3 (R); + 2 |
| | Activity planning | 7 | 5 | 2 (I) |
| | Preparation of technological devices | 11 | 6 | 3 (C); 1 (I); 1(R) |
| | Preparation of virtual learning materials | 8 | 0 | 3 (C), 3 (R); - 2 |
| | Study strategy planning | 7 | 5 | 2 (I) |
| Execution (from 53 to 27) | Goal setting | 7 | 5 | 2 (R) |
| | Self-motivation | 8 | 5 | 1 (C); 2 (R) |
| | Work approach monitoring | 11 | 4 | 4 (C); 3 (R) |
| | Learning achievement monitoring | 14 | 7 | 5 (C); 1 (I); 1 (R) |
| | Time and activity organization monitoring | 15 | 8 | 5 (C); 2 (R) |
| | Help-seeking strategies | 13 | 8 | 4 (C); 1 (I) |
| Assessment (from 37 to 20) | Self-judgment | 14 | 10 | 4 (C) |
| | Self-reaction and self-satisfaction | 23 | 10 | 5 (C); 5 (R); 3 (I) |

*Note*. (C) indicates the items removed due to lack of clarity in wording and for being duplicated or redundant with better-phrased items; (R) corresponds to items discarded due to low relevance to the subdimension; (I) refers to items eliminated due to their low importance for the estimation of the subdimension.

Using this version, an initial EFA was conducted, with a sample of 202 university students,

separate from the main study sample of 1,147 participants, with the aim of improving and/or replacing items to ensure that the most relevant are included for the final application (Soriano Rodríguez, 2015).

**Planning Dimension**. The subdimensions *Time planning* and *Activity planning* were merged and renamed as *Time management*, including items 1, 2, 6, 12, and 13, plus a new item. *Study strategy planning*, *Goal setting* and *Self-motivation* were merged into a new subdimension: *Management of study goals and purposes*, which included items 23, 24, 25, 28, 30, 33, and 34. The subdimension *Study environment preparation* remained with items 7, 8, 18, and 19, plus a new item. The remaining items on the subdimension *Preparation of technological devices* appeared to focus more on resources rather than on preparing devices, changing the name to *Preparation of digital materials and resources*, including items 10, 20, and 26, plus a new item. The other items were removed due to having factor loadings below 0.4. Since some of these were of high theoretical relevance, the three new items were developed to be clearer in evaluating their intended constructs. In total, out of the original 37 items, 17 items were removed, and 3 new ones were created. Consequently, the Planning dimension comprised 4 subdimensions with 23 items.

**Execution Dimension**. The subdimensions *Work approach monitoring*, *Learning achievement monitoring* and *Time and activity organization monitoring* were merged into a new subdimension: *Personal strategies for learning monitoring*, including items 38, 39, 40, 46, 47, 49, 52, 53, 54, 56, 57, and 58. A new factor was formed with items 44 and 45. Since both addressed external comparison parameters used by students to evaluate their study, a new subdimension, *External parameters for learning monitoring*, was created and strengthened with four additional items addressing other external information sources available for study monitoring. The subdimension *Help-seeking strategies* remained with its original items, except for 57 and 58, which refer to the search for support materials, loading onto *Personal strategies for learning monitoring*. The remaining items alluded to strategies for seeking help from other educational actors, changing the name to *Social strategies for learning monitoring*. A new item was created to include the professor as a source of support. The other items were removed due to factor loadings below 0.4. In total, out of the original 27 items, 7 items were removed, and 5 new ones were created. Therefore, the Execution dimension consisted of 3 subdimensions with 25 items.

**Assessment Dimension**. The items were organized into four factors. Most items were grouped into three subdimensions regarding self-judgments: *Evaluation of the study environment and materials* (items 68, 69, 71, 72, and 79), *Evaluation of study strategies* (items 65, 66, 67, 74, 75, 76, and 77), and *Evaluation of the learning quality*. This last factor remained composed of two items with factor loadings below 0.4, and so they were eliminated. Given the relevance of having a subdimension where the student evaluates the quality of their learning, 5 new items were designed. In the fourth dimension, items 82, 83, and 84 were grouped due to being linked to cognitive-motivational themes that include affective elements involved in the processes of success or failure in learning. To strengthen the subdimension, three new items were designed. Therefore, its name changed from *Self-reaction and self-satisfaction* to *Self-motivation reactions*. The other items were removed due to factor loadings below 0.4. In total, from the original 20 items, 5 were removed and 8 new ones were created, leaving the Assessment dimension with a

total of 23 items.

The final version of the instrument was piloted with 32 university students to evaluate the clarity of the instructions and the appropriateness of the language, with no issues reported.

### *Procedure*

Research Procedures

The final version of the questionnaire was transferred to an electronic form and was sent once via institutional email to the student population. The email detailed the purposes and boundaries of the study. Before answering the questions, participants were required to sign an informed consent form. The form remained open from January to March of 2024.

### *Data Analysis Procedures*

For the statistical analyses, the sample was randomly divided into two groups, considering the faculty to which they belonged, the declared major and gender. Subsequently, a descriptive analysis of the sample was conducted. Also, a verification of outliers was performed using Mahalanobis distance, identifying outliers in 100 observations. The items, in univariate analysis, presented skewness and kurtosis within the range of ±1.5, adhering to the criteria suggested by Pérez and Medrano (2007), and therefore were not eliminated.

An EFA was conducted with the first subsample (556 students) employing a polychoric correlation matrix, given that the items were evaluated using a 5-point ordinal scale. The suitability of data was assessed using the Kaiser-Meyer-Olkin (KMO) sampling adequacy index and Bartlett's test of sphericity. The optimal number of factors was determined using Horn's parallel analysis and the Eigenvalue criterion. The EFA was performed using generalized least squares extraction and geomin oblique rotation. An iterative process was carried out to improve the factorial solution where in each iteration, potential issues such as cross-loadings or items without significant loadings were analyzed to decide on their elimination. This process was repeated for each dimension until a final solution was obtained without issues, where each item was associated with a single factor with a loading of 0.4 or higher.

Subsequently, a CFA was conducted with the second subsample (591 students). The correlation matrix of all considered items verified the absence of collinearity, as no values exceeded 0.85 (Cupani, 2012; Kline, 2011). Robust Maximum Likelihood (RML) estimation was employed. According to Holgado-Tello et al. (2016), this method is a variant of the Maximum Likelihood (ML) approach, designed to address the limitations that arise when data do not meet the assumptions of multivariate normality, and the variables are ordinal in nature. Unlike the traditional ML method, which assumes normality in observed variables, RML uses an asymptotic covariance (AC) matrix to generate a freely distributed weight matrix. This approach allows for a more precise fit when the observed variables do not follow a normal distribution (Holgado-Tello et al., 2016).

The CFA was conducted for each scale and its subdimensions. An analysis was performed based on a third-order factorial structure, considering the subdimensions of each scale, as well as how these scales are explained by a broader factor (SRL). For goodness-of-fit, the indices CFI and TLI (>0.90) and RMSEA and SRMR (<0.10) were considered (Hair et al., 2019). Reliability was

assessed using Cronbach's α and McDonald's ω coefficient, and variance extracted was evaluated using the AVE coefficient. These analyses were performed using JASP software (version 0.18.3.0).

# Results

The results are organized based on the analyses conducted. First, a descriptive analysis of the sample is presented, followed by an EFA for each scale. Subsequently, a CFA was performed for each scale and the third-order structure. The reliability of the subdimensions, each scale, and the complete questionnaire were reported.

### *Descriptive Analysis*

The descriptive analyses of the questionnaire's items can be seen in Appendix 2. Most items exhibit skewness and kurtosis within the range of ±1.5. No items were removed, indicating that the response distribution is concentrated on the higher scores of the scale. No anomalies were found.

### *EFA of the Scales Comprising SRL in BL Questionnaire*

The factorial validity of each scale, as well as their subdimensions, was assessed.

### *EFA of the Planning Scale*

The KMO index has a value of .91, and Bartlett's test of sphericity yielded a value of $X^2$ (210) = 65,481.75, $p < .001$, indicating that the polychoric correlation matrix is suitable for conducting a factor analysis. Using Horn's parallel analysis, it was determined that the optimal number of factors for the factorial solution is four, while the Eigenvalue criterion suggested five factors. Given this variation, a solution considering five factors was initially evaluated (Table 2).

**Table 2**

*Iterative Process for Improving the Factorial Solution of the Planning Scale*

| Solution No. | Items | Factors | Explained variance | Detected issues | Action |
|---|---|---|---|---|---|
| 1 | 23 | 5 | 53.34 | Items with cross-loadings: 10–12 | Remove items 10–12 |
| 2 | 21 | 5 | 54.36 | Item without loading: 5 | Remove item 5 |
| 3 | 20 | 5 | 54.61 | Items with cross-loadings: 18–19 | Remove items 18–19 |
| 4 | 18 | 5 | 55.44 | No issues | |

Table 3 presents the final factorial solution with 18 items for the Planning scale. The first factor, *Time management*, comprises items PLA14, PLA15, PLA16, and PLA17. The second factor, *Study environment preparation*, comprises items PLA9, PLA11, and PLA13. The third factor, *Learning purposes*, comprises items PLA1, PLA2, PLA3, and PLA4. The fourth factor, *Preparation of materials and digital resources*, comprises items PLA20, PLA21, PLA22, and PLA23. The fifth factor, *Study strategy selection*, comprises items PLA6, PLA7, and PLA8.

**Table 3**
*Exploratory Factor Solution of the Planning Scale*

| Items | Factors | | | | |
|---|---|---|---|---|---|
| | Time management | Study environment preparation | Learning purposes | Preparation of materials and digital resources | Study strategy selection |
| PLA16 | .84 | | | | |
| PLA15 | .69 | | | | |
| PLA14 | .59 | | | | |
| PLA17 | .53 | | | | |
| PLA11 | | .83 | | | |
| PLA9 | | .78 | | | |
| PLA13 | | .70 | | | |
| PLA2 | | | .72 | | |
| PLA4 | | | .67 | | |
| PLA3 | | | .66 | | |
| PLA1 | | | .66 | | |
| PLA20 | | | | .71 | |
| PLA21 | | | | .68 | |
| PLA22 | | | | .57 | |
| PLA23 | | | | .54 | |
| PLA7 | | | | | .90 |
| PLA6 | | | | | .70 |
| PLA8 | | | | | .65 |

*Note.* The extraction method used was Unweighted Least Squares and the rotation method was Oblimin with Kaiser normalization. The rotation converged in 8 iterations.

### *EFA of the Execution Scale*

A KMO index of .92 was identified, and Bartlett's test of sphericity yielded a value of $X^2$ (300) = 7486.65, $p < .001$, indicating that the correlation matrix is suitable for conducting a factor analysis. Using Horn's parallel analysis, it was determined that the optimal number of

factors for the factorial solution is three. However, the Eigenvalue criterion suggests that the optimal solution consists of four factors, so the analysis was conducted with four factors (Table 4).

**Table 4**
*Iterative Process for Improving the Factorial Solution of the Execution Scale*

| Solution No. | Items | Factors | Explained variance | Detected issues | Action |
|---|---|---|---|---|---|
| 1 | 25 | 4 | 52.16 | Items without loading: 7–8–19–25 | Remove items 7–8–19–25 |
| 2 | 21 | 4 | 56.19 | Items with cross-loadings: 1–3–6–14–18–23 | Remove items 1–3–6–14–18–23 |
| 3 | 15 | 3 | 56.07 | Item with cross-loading: 2 | Remove item 2 |
| 4 | 14 | 3 | 57.33 | No issues | |

Table 5 presents the final factorial solution of the Execution scale, consisting of 14 items. The first factor, *External parameters for self-monitoring*, comprises items EX20, EX21, EX22, and EX24. The second factor, *Personal strategies for self-monitoring*, comprises items EX4, EX5, EX9, EX10, EX11, and EX12. The third factor, *Social strategies for self-monitoring*, comprises items EX13, EX15, EX16, and EX17.

**Table 5**
*Factorial Solution of the Execution Scale*

| Items | Factors | | |
|---|---|---|---|
| | External parameters for self-monitoring | Personal strategies for self-monitoring | Social strategies for self-monitoring |
| EX21 | .91 | | |
| EX22 | .79 | | |
| EX20 | .76 | | |
| EX24 | .70 | | |
| EX9 | | .76 | |
| EX12 | | .68 | |
| EX10 | | .68 | |
| EX11 | | .65 | |

| | | |
|---|---|---|
| EX5 | .61 | |
| EX4 | .46 | |
| EX15 | | .93 |
| EX16 | | .93 |
| EX17 | | .77 |
| EX13 | | .51 |

*Note.* Method of extraction: Unweighted least squares. Method of rotation: Oblimin with Kaiser normalization. a. The rotation converged in 9 iterations.

***EFA of the Assessment scale***

A KMO index of .95 was identified, and Bartlett's test of sphericity yielded a value of $X^2$ (253) = 10,014.52, $p < .001$, indicating that the correlation matrix is suitable for conducting a factor analysis. Using Horn's parallel analysis, it was determined that the optimal number of factors for the factorial solution is four. The Eigenvalue criterion also suggests that the optimal solution consists of four factors; therefore, the analysis was conducted with four factors (Table 6).

**Table 6**

*Iterative Process for Improving the Factorial Solution of the Assessment Scale*

| Solution No. | Items | Factors | Explained variance | Detected issues | Action |
|---|---|---|---|---|---|
| 1 | 23 | 4 | 64.07 | Items with cross-loadings: 1–2–4–6 | Remove items 1–2–4–6 |
| 2 | 19 | 4 | 64.87 | Items with cross-loadings: 15–19–21–22–23 | Remove items 15–19–21-22–23 |
| 3 | 14 | 2 | 56.21 | No issues | |

Table 7 presents the final factorial solution of the Assessment scale, which grouped the initial four subdimensions into two factors. These factors explain 56.21% of the variance. The first factor, *Self-judgment*, comprises items SA3, SA5, SA7, SA8, SA9, SA10, SA11, SA12, and SA20. The second factor, *Self-motivation*, comprises items SA13, SA14, SA16, SA17, and SA18.

**Table 7**

*Factorial Solution of the Assessment Scale*

| Items | Factors | |
|---|---|---|
| | Self-judgment | Self-motivation |
| SA12 | .93 | |

| | | | |
|---|---|---|---|
| SA7 | .90 | | |
| SA8 | .90 | | |
| SA9 | .82 | | |
| SA5 | .73 | | |
| SA11 | .70 | | |
| SA20 | .63 | | |
| SA3 | .60 | | |
| SA10 | .60 | | |
| SA14 | | | .77 |
| SA13 | | | .76 |
| SA18 | | | .72 |
| SA17 | | | .69 |
| SA16 | | | .64 |

*Note.* Method of extraction: Unweighted least squares. Method of rotation: Oblimin with Kaiser normalization. The rotation converged in 3 iterations.

### *CFA of the SRL Questionnaire*

A third-order CFA was conducted to assess the model fit, considering the dimensions and the general factor. Table 8 presents the fit results for each model analyzed.

**Table 8**

*Fit Indices of the CFA for the SRL Questionnaire*

| Models | $X^2$ | $X^2$/ gl | IFC | TLI | SRMR | RMSEA |
|---|---|---|---|---|---|---|
| Planning scale | 465.10 (125) | 3.72* | .93 | .92 | .04 | .07 |
| Execution scale | 210.79 (51) | | .95 | .93 | .05 | .07 |
| Assessment scale | 186.19 (34) | 5.48* | .95 | .94 | .04 | .09 |
| Self-regulation Three Factors | 1197.3 (652) | 1.84* | 0.88 | 0.87 | 0.06 | 0.063 |
| Self-regulation Three | 996.7 (652) | 1.53* | 0.92 | 0.92 | 0.06 | 0.05 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Factors c/err correl. | | | | | | | | | | |

*Note.* *p < .001; MLR estimator.

For the Planning scale, the analysis showed a value of $X^2$ (125) = 465.1, indicating discrepancies between the model and the data. However, it is important to note that the chi-square value can be sensitive to sample size (Kline, 2016). The $X^2$/df ratio was 3.72, which falls within an acceptable range (Byrne, 2010). The CFI and TLI fit indices indicate a good model fit (Hu & Bentler, 1999). Similarly, the SRMR also demonstrates a good model fit (Kline, 2016). The RMSEA was .068, suggesting a reasonable fit (Browne & Cudeck, 1993).

For the Execution scale, the chi-square value was $X^2$ (51) = 210.789, and the fit indices were CFI = .95 and TLI = .93, indicating excellent model fit (Hu & Bentler, 1999). The SRMR was .047, showing that the model's residuals were small, and the RMSEA was .07, which is considered an acceptable fit (Browne & Cudeck, 1993).

For the Assessment scale, the chi-square value of $X^2$ (34) = 186.19 indicated discrepancies, and the $X^2$/df ratio was 5.48, which could suggest fit issues (Kline, 2016). However, the CFI and TLI were .95 and .94, respectively, indicating good fit (Hu & Bentler, 1999). The SRMR was .04, reflecting small residuals, while the RMSEA was .09, suggesting that the model fit could be improved (Browne & Cudeck, 1993).

The Three-Factor Self-Regulation Model presented a chi-square value of $X^2$ (652) = 1197.3, with an $X^2$/df ratio of 1.84, indicating good fit (Byrne, 2010). However, the CFI and TLI indices were .88 and .87, respectively, suggesting that the model did not reach the desired threshold of .90 (Hu & Bentler, 1999). The SRMR was .06, indicating acceptable fit, and the RMSEA was .06, suggesting reasonable fit. Therefore, it was necessary to re-specify the model by considering correlations between item errors. These correlations were identified through modification indices. The items with correlated errors were as follows: SA13~SA14, SA3~SA5, SA7~SA8, PLA2~PLA4, PLA1~PLA3, EJ9~EJ10, and EJ11~EJ12. After this adjustment, the Three-Factor Self-Regulation Model showed a significant improvement in fit. The final model is a correlated three-factor structure, composed of Planning, Execution, and Assessment as first-order latent variables. Although a third-order model was initially tested, the best fit was achieved with the correlated model, without assuming a hierarchical structure. This configuration reflects three distinct but interrelated components of SRL.

### *Reliability Analysis of the SRL Questionnaire*

The results regarding the reliability of the questionnaire can be found in Appendix 3, which presents Cronbach's α coefficients, and also includes McDonald's ω coefficients to provide a more robust assessment of internal consistency reliability. Adequate consistency indices were identified for the Planning scale, ranging from α = .74 to α = .87. For the Execution scale, the levels of internal consistency were also adequate, ranging from α = .78 to α = .86. The Assessment scale showed high internal consistency, with values ranging from α = .83 to α = .89. The final version of the questionnaire can be found in Appendix 4.

# Discussion

This study provides evidence on the validity and reliability of a questionnaire designed to measure SRL in higher education BL contexts. Evaluating students' perceptions of their SRL strategies in contemporary higher education emphasizes the importance of incorporating new and specific behaviors beyond those outlined by previous SRL theories. These behaviors are tailored to meet the demands of a BL education model, which increases the complexity of the construct by introducing subdimensions for each of them, providing a more precise understanding of what students must do to self-regulate their learning in these settings.

### *Factorial Validity and Model Fit*

The analyses indicate that the questionnaire has a well-defined factorial structure, with subdimensions that adequately reflect the theoretical constructs of SRL stages. The elimination of items with cross-loadings or low factor loadings was necessary to optimize the model. This is reflected in the high fit indices obtained in the CFA. The factors in each scale are consistent with prior literature, demonstrating that SRL is a multifaceted construct, reflected in time organization and management, effective study preparation and the establishment of clear learning purposes (Panadero, 2017; Zimmerman & Schunk, 2011).

### *Planning Scale*

The scale explains 55.44% of the variance and encompasses dimensions such as *Time management*, *Study environment preparation*, and *Learning purposes*. These dimensions align with the fundamental processes of the planning stage in SRL theory (Zimmerman, 2000), which is characterized by students' ability to set specific goals, plan their activities and select appropriate strategies to achieve them, elements that have been validated in various psychometric studies (Pintrich, 2004; Wolters & Benzon, 2013). Therefore, these dimensions have also been empirically supported, identifying planning as a critical factor for academic success in BL contexts (Broadbent & Poon, 2015; Dent & Koenka, 2016). Distinguishing behaviors such as time management, study environment preparation, learning purposes, material preparation and study strategy planning allow for a comprehensive approach to aspects students must anticipate for successful study. This approach helps reduce stress and anxiety associated with academic workload (Hinds & Sanchez, 2022; Knezevic et al., 2023; Lobos et al., 2023b). By having greater control over their learning and progress, students feel more confident and less overwhelmed, particularly in BL environments, where research has highlighted that students perceive a greater time demand for virtual activities (Aristovnik et al., 2020; Zhang et al., 2023). In the subdimension *Study environment preparation,* items are associated with characteristics of the physical environment, such as having a comfortable and distraction-free space. This aligns with research emphasizing the importance of having suitable environments for online study (Aguilar Gordón, 2020; Barrientos Oradini et al., 2022). Items related to the quality of the internet connection and technological equipment were removed due to cross-loadings. These items demonstrated greater affinity with the subdimension *Preparation of materials and digital resources*, suggesting that the availability of internet and technological equipment is perceived as a personal responsibility of the student rather than a characteristic of the study environment. This raises questions about the adequacy of spaces provided by universities to meet these needs. There is a consensus that the responsibility for ensuring equitable conditions and equal access lies with educational institutions and/or the State (Aguilar Gordón, 2020; Hodges et al., 2020). Finally, the original subdimension *Management of study goals and purposes* was divided into

two parts: *Study strategy selection*, which includes behaviors such as the search and selection of study strategies, and *Learning Purposes*, which refer to cognitive actions and self-instructions that help students give meaning and utility to what they are about to learn (Díaz Mujica et al., 2019; Lobos et al., 2021).

***Execution Scale***

The scale demonstrated a clear and robust factorial structure, with an explained variance falling within the ranges considered appropriate for psychological measurement instruments. In the final iteration of the factor analysis, no significant fit issues were identified, suggesting that the underlying structure of the Execution construct is well-defined and consistent with the observed data (Byrne, 2016). The model fit indices, such as the CFI and the RMSEA, showed values indicating a good fit of the model to the data, which is essential to ensure the instrument's validity (Hu & Bentler, 1999). Furthermore, the high variance explained by the main factors reinforces the instrument's ability to capture the essential dimensions of the Execution construct in the context of SRL (Kline, 2016). The absence of fit issues in the final iteration of the CFA also indicates that the items are highly correlated with their respective subdimensions, minimizing the likelihood of unexplained variance and reinforcing the construct validity of the instrument (Tabachnick & Fidell, 2013).

The subdimension *Personal strategies for self-monitoring* largely retained its original items. These strategies are fundamental for students to take advantage of the flexibility offered by the virtual component, enabling them to self-manage their study through efficient and effective monitoring of their time, study methods and learning strategies. Additionally, they allow students to verify whether they are achieving the expected learning outcomes (Bernardo et al., 2020; Taranto & Buchanan, 2020) and foster an elevated level of awareness about the study process, enhancing the student's ability to manage distractions inherent to online environments (Chiu & Hinds, 2022; Jin et al., 2023). As noted by Otazú López and collaborators (2022), the same technology that facilitates online education can also be a source of distraction, with notifications from social media, emails and other applications interrupting the study flow. While multitasking may seem efficient, it can decrease concentration and the quality of learning (Geçer & Bağci, 2022; Otazú López et al., 2022). Students may feel tempted to engage in other activities during virtual classes, reducing their attention and comprehension. This highlights the importance of task checklists, learning verification and seeking additional materials as central elements in the execution stage.

In the subdimension *Social strategies for self-monitoring*, all remaining items relate to peer interaction, emphasizing the critical role peers play in the execution phase. While the importance of social support in learning is widely recognized (Fraile et al., 2020; Khan et al., 2023), peers also serve as points of comparison, offering a distinct source of information beyond social support. For example, if a student observes that their peers have already reviewed a material, this signals they are falling behind and need to catch up. Similarly, if they notice their peers share the same doubts, they may interpret that it is not an individual issue, making it easier for them to seek help.

***Assessment Scale***

In the first factor, *Self-judgment,* the original subdimension *Evaluation of study strategies*

absorbed two items from the other original subdimension *Evaluation of study environment and materials*. These items were more broadly worded and encompassed the content of others that were removed due to low loadings. This indicates that students place greater emphasis on evaluating their learning strategies and study methods and, to a lesser extent, on the physical space and study environment.

The second factor, which corresponds to the *Self-motivation* subdimension, only had one item removed due to low loading. The inclusion of behaviors at this stage, associated with affective-motivational factors, highlights the challenge students face in BL environments to stay motivated and organized without the constant structure of in-person classes or the recognition and encouragement that a teacher might provide (Besser et al., 2022; Chiu & Hinds, 2022; Guppy et al., 2022). Self-motivation strategies aimed at encouraging oneself and setting aside negative thoughts are essential to sustain students' efforts in overcoming obstacles. Positive motivation and a constructive mindset help maintain persistence, reduce stress and increase self-confidence, which in turn enhances academic performance and the ability to overcome challenges (Luján Henríquez & Martín Rodríguez, 2021; Vences Camacho et al., 2023).

***Reliability***

Reliability indices obtained for the scales are satisfactory, with Cronbach's alpha and omega values greater than .74 in all subscales. Reliability is a critical component in psychometric evaluation, as it ensures that the measurement instrument produces consistent and accurate results over time and across different population groups (DeVellis, 2017). A highly reliable instrument not only allows for a more accurate evaluation of SRL but also ensures that interventions based on its results are more effective and well-grounded (Streiner, 2003).

The internal consistency observed supports the proposed factorial structure of the questionnaire, suggesting that the dimensions are clearly defined and well-differentiated, a crucial aspect for the construct validity of the instrument (Cortina, 1993). Reliability indices reinforce the utility of the questionnaire as a tool for evaluating SRL in higher education settings. The developed questionnaire not only offers a valid and reliable tool to measure SRL but can also be used by professionals to identify areas of strength and need among students, enabling the design of more effective interventions to promote self-regulation.

None of the dimensions distinguish between SRL behaviors in face-to-face and online education contexts, allowing the instrument to also be applicable in e-learning or technology-mediated study environments. Regarding this, the online resources and tools students use to enhance their SRL are already part of their autonomous study processes and are utilized regardless of the modality of their courses.

Previously designed instruments, such as MSLQ (Pintrich et al., 1991), LASSI (Weinstein et al., 1987), OSLQ (Barnard-Brak et al., 2010), and SOL-Q (Jansen et al., 2017), were primarily designed for traditional face-to-face settings or for early stages of online learning and tend to focus on partial dimensions of SRL. More recent tools like the SRL-O (Broadbent et al., 2023) focus mainly on the planning phase and do not fully address the regulatory demands of BL environments. The instrument developed in this study operationalizes SRL in a comprehensive manner, incorporating cognitive, motivational, and emotional components. Moreover, it was developed based on the direct experiences of students engaged in BL contexts,

providing greater contextual validity and theoretical coherence for current hybrid learning scenarios.

### *Limitations and Recommendations*

Response bias toward higher scores may limit the generalization of results to populations with different levels of motivation or experience in BL environments. This bias could be influenced by the fact that all participants belong to a single university and most of them are from the same year, reflecting characteristics of that institution such as its academic culture or the profile of its students. Furthermore, the item elimination process during EFA may have reduced response diversity, potentially losing valuable information about variations in student responses, and limiting the questionnaire's ability to fully capture SRL behaviors across contexts. Also, the use of self-report measures based on retrospective recall may introduce bias and affect the validity of the findings, particularly given the complexity of the SRL construct. Results predominantly reflect data collected from first-year students from the same university, which means that the generalizability of these findings to the broader university population is restricted. Future research should explore the application of the questionnaire in more advanced years and different educational contexts, with more diverse populations to evaluate its generalized validity. Additionally, research should investigate how interventions based on the questionnaire's results can influence the academic success of students in BL environments.

## Conclusions

This study provides an instrument easy and quick to administer, enabling the assessment of SRL strategies in BL educational contexts.

Study processes in BL contexts require additional strategies to achieve effective SRL. Therefore, educational institutions should enhance their initiatives to promote SRL among students by incorporating these findings into course designs, encouraging students to develop planning, monitoring and autonomous evaluation strategies.

Moreover, the tools of educational platforms such as Learning Management Systems (e.g., CANVAS, D2L), collaborative work applications (e.g., Microsoft Teams, Google Docs) and others, can be intentionally used to develop developing SRL skills. Specifically, virtual classroom functionalities should be employed to help students organize and track their academic progress. Given that the current job market demands professionals with strong digital competencies, promoting SRL also enhances the reputation and performance of educational institutions by better preparing their graduates for success in their future careers and in life.

### *Declarations*

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# Appendix A

**Table 1**

*Description of Subdimensions of the Questionnaire*

| Dimensions | Sub-dimensions |
|---|---|
| Planning (64): stage in which the student decides what they want to achieve, how they will approach it, and how they will organize themselves to achieve their learning goals. | 1. Time planning (8)<br>2. Study environment preparation (8)<br>3. Activity planning (7)<br>4. Preparation of technological devices (11)<br>5. Preparation of virtual learning materials (8)<br>6. Study strategy planning (7)<br>7. Goal setting (7)<br>8. Self-motivation (8) |
| Execution (53): stage in which the student gets actively involved in their learning process, performs the planned activities and applies the chosen strategies to achieve their learning goals. | 1. Work approach monitoring (11)<br>2. Learning achievement monitoring (14)<br>3. Time and activity organization monitoring (15)<br>4. Help-seeking strategies (13) |
| Assessment (37): stage in which the student analyzes to what extent they have achieved their learning goals; the effectiveness of the strategies used and considers how they could improve in future learning situations. | 1. Self-judgment (14)<br>2. Self-reaction and self-satisfaction (23) |

*Note*. In parentheses the number of items developed for each subdimension is presented.

# Appendix B

**Table 1**

*Descriptive Statistics of the Items in the Self-Regulation Questionnaire*

| Dimension | Items | Min | Max | Average | Std. Deviation | Asymmetry | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Statistical | Std. Error | Statistical | Std. Error |
| Planning | PLA1 | 1 | 5 | 4.1 | 1.1 | -1.23 | .1 | 1.13 | .21 |
| | PLA2 | 1 | 5 | 4.2 | 1.0 | -1.28 | .1 | 1.26 | .21 |
| | PLA3 | 1 | 5 | 4.3 | 0.9 | -1.32 | .1 | 1.50 | .21 |
| | PLA4 | 1 | 5 | 4.3 | 0.8 | -1.24 | .1 | 1.59 | .21 |
| | PLA5 | 1 | 5 | 4.2 | 1.0 | -1.12 | .1 | 0.87 | .21 |
| | PLA6 | 1 | 5 | 4.0 | 1.0 | -.92 | .1 | 0.12 | .21 |
| | PLA7 | 1 | 5 | 4.0 | 1.1 | -.80 | .1 | -0.12 | .21 |
| | PLA8 | 1 | 5 | 4.1 | 1.0 | -1.12 | .1 | 0.79 | .21 |
| | PLA9 | 1 | 5 | 4.6 | 0.8 | -1.99 | .1 | 3.67 | .21 |
| | PLA10 | 1 | 5 | 4.5 | 0.9 | -1.84 | .1 | 3.22 | .21 |
| | PLA11 | 1 | 5 | 4.5 | 0.8 | -1.72 | .1 | 2.78 | .21 |
| | PLA12 | 1 | 5 | 4.6 | 0.7 | -2.04 | .1 | 4.53 | .21 |
| | PLA13 | 1 | 5 | 4.7 | 0.6 | -2.38 | .1 | 6.90 | .21 |
| | PLA14 | 1 | 5 | 3.6 | 1.3 | -.41 | .1 | -0.87 | .21 |
| | PLA15 | 1 | 5 | 3.9 | 1.0 | -.72 | .1 | -0.11 | .21 |
| | PLA16 | 1 | 5 | 3.5 | 1.2 | -.39 | .1 | -0.85 | .21 |
| | PLA17 | 1 | 5 | 4.0 | 1.1 | -.92 | .1 | 0.09 | .21 |
| | PLA18 | 1 | 5 | 4.0 | 1.1 | -1.05 | .1 | 0.26 | .21 |
| | PLA19 | 1 | 5 | 4.0 | 1.2 | -.98 | .1 | 0.10 | .21 |
| | PLA20 | 1 | 5 | 4.0 | 1.2 | -.96 | .1 | -0.03 | .21 |
| | PLA21 | 1 | 5 | 3.5 | 1.3 | -.46 | .1 | -0.88 | .21 |
| | PLA22 | 1 | 5 | 4.4 | 0.9 | -1.51 | .1 | 2.39 | .21 |
| | PLA23 | 1 | 5 | 4.4 | 0.9 | -1.56 | .1 | 2.45 | .21 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | EX1 | 1 | 5 | 3.9 | 1.9 | -.94 | .1 | 0.35 | .21 |
| | EX2 | 1 | 5 | 3.8 | 1.1 | -.75 | .1 | -0.21 | .21 |
| | EX3 | 1 | 5 | 4.1 | 1.0 | -.93 | .1 | 0.17 | .21 |
| | EX4 | 1 | 5 | 4.1 | 1.0 | -.97 | .1 | 0.14 | .21 |
| | EX5 | 1 | 5 | 4.0 | 1.0 | -.86 | .1 | 0.20 | .21 |
| | EX6 | 1 | 5 | 4.1 | 1.0 | -1.02 | .1 | 0.52 | .21 |
| | EX7 | 1 | 5 | 3.7 | 1.4 | -.66 | .1 | -0.86 | .21 |
| | EX8 | 1 | 5 | 3.6 | 1.0 | -.35 | .1 | -0.44 | .21 |
| | EX9 | 1 | 5 | 4.4 | 0.8 | -1.35 | .1 | 1.72 | .21 |
| | EX10 | 1 | 5 | 4.2 | 0.9 | -1.21 | .1 | 1.00 | .21 |
| | EX11 | 1 | 5 | 4.3 | 0.9 | -1.26 | .1 | 1.05 | .21 |
| | EX12 | 1 | 5 | 4.4 | 0.8 | -1.51 | .1 | 1.99 | .21 |
| | EX13 | 1 | 5 | 4.0 | 1.1 | -1.07 | .1 | 0.44 | .21 |
| | EX14 | 1 | 5 | 4.1 | 1.1 | -1.15 | .1 | 0.72 | .21 |
| | EX15 | 1 | 5 | 3.9 | 1.2 | -0.88 | .1 | -0.08 | .21 |
| | EX16 | 1 | 5 | 3.9 | 1.2 | -0.77 | .1 | -0.52 | .21 |
| | EX17 | 1 | 5 | 4.1 | 1.1 | -0.96 | .1 | -0.02 | .21 |
| | EX18 | 1 | 5 | 4.1 | 1.0 | -0.91 | .1 | 0.03 | .21 |
| Execution | EX19 | 1 | 5 | 3.4 | 1.4 | -0.40 | .1 | -1.05 | .21 |
| | EX20 | 1 | 5 | 3.5 | 1.3 | -0.40 | .1 | -0.92 | .21 |
| | EX21 | 1 | 5 | 3.5 | 1.3 | -0.44 | .1 | -0.86 | .21 |
| | EX22 | 1 | 5 | 3.5 | 1.4 | -0.46 | .1 | -0.98 | .21 |
| | EX23 | 1 | 5 | 3.5 | 1.2 | -0.48 | .1 | -0.81 | .21 |
| | EX24 | 1 | 5 | 3.6 | 1.2 | -.057 | .1 | -0.61 | .21 |
| | EX25 | 1 | 5 | 4.2 | 1.0 | -1.24 | .1 | 1.03 | .21 |
| | SA1 | 1 | 5 | 3.6 | 1.2 | -0.60 | .1 | -0.59 | .21 |
| Assessment | SA2 | 1 | 5 | 3.7 | 1.2 | -0.69 | .1 | -0.33 | .21 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SA3 | 1 | 5 | 4.0 | 1.2 | -1.02 | .1 | 0.16 | .21 |
| | SA4 | 1 | 5 | 3.8 | 1.1 | -0.76 | .1 | -0.14 | .21 |
| | SA5 | 1 | 5 | 4.0 | 1.1 | -0.95 | .1 | 0.05 | .21 |
| | SA6 | 1 | 5 | 4.0 | 1.05 | -1.08 | .1 | 0.74 | .21 |
| | SA7 | 1 | 5 | 4.0 | 1.1 | -1.02 | .1 | 0.39 | .21 |
| | SA8 | 1 | 5 | 4.0 | 1.1 | -0.95 | .1 | 0.06 | .21 |
| | SA9 | 1 | 5 | 4.0 | 1.1 | -1.03 | .1 | 0.41 | .21 |
| | SA10 | 1 | 5 | 3.7 | 1.2 | -.62 | .1 | -0.50 | .21 |
| | SA11 | 1 | 5 | 4.1 | 1.1 | -1.10 | .1 | 0.60 | .21 |
| | SA12 | 1 | 5 | 4.0 | 1.1 | -0.97 | .1 | 0.19 | .21 |
| | SA13 | 1 | 5 | 3.9 | 1.3 | -0.79 | .1 | -0.64 | .21 |
| | AA14 | 1 | 5 | 3.6 | 1.3 | -0.52 | .1 | -0.98 | .21 |
| | SA15 | 1 | 5 | 4.0 | 1.1 | -1.05 | .1 | 0.33 | .21 |
| | SA16 | 1 | 5 | 3.8 | 1.2 | -0.73 | .1 | -0.24 | .21 |
| | SA17 | 1 | 5 | 3.3 | 1.3 | -0.25 | .1 | -0.92 | .21 |
| | SA18 | 1 | 5 | 3.9 | 1.1 | -.85 | .1 | 0.07 | .21 |
| | SA19 | 1 | 5 | 4.0 | 1.0 | -1.02 | .1 | 0.65 | .21 |
| | SA20 | 1 | 5 | 4.4 | 0.8 | -1.44 | .1 | 2.32 | .21 |
| | SA21 | 1 | 5 | 4.1 | 1.0 | -0.97 | .1 | 0.52 | .21 |
| | SA22 | 1 | 5 | 4.2 | 0.9 | -1.17 | .1 | 1.31 | .21 |
| | SA23 | 1 | 5 | 4.0 | 1.0 | -1.00 | .1 | 0.39 | .21 |

# Appendix C

**Table 1**

*Internal Consistency of the SRL Questionnaire*

| Dimensions | Alpha | Omega |
|---|---|---|
| Time management | .87 | .86 |
| Study environment preparation | .86 | .84 |
| Learning purposes | .83 | .84 |
| Preparation of materials and digital resources | .74 | .73 |
| Study strategy selection | .84 | .83 |
| Planning scale | .92 | .91 |
| External parameters for self-monitoring | .86 | .87 |
| Personal strategies for self-monitoring | .83 | .83 |
| Social strategies for self-monitoring | .78 | .81 |
| Execution scale | .87 | .89 |
| Self-judgment | .89 | .89 |
| Self-motivation | .83 | .84 |
| Assessment scale | .89 | .91 |

# Appendix D

Questionnaire for Self-regulated Learning in Blended or Technology-Mediated Learning Environments in Higher Education

**Instruction**: Below you will find a series of statements regarding how you organize and carry out your study in learning environments that combine face-to-face and virtual activities.
Read each statement carefully and indicate how frequently you perform that action when studying.
To respond, use the following 1-to-5 scale, where 1 means 'Never' and 5 means 'Always':
1 = Never | 2 = Almost never | 3 = Sometimes | 4 = Almost always | 5 = Always
Respond according to your actual experience. There are no right or wrong answers.

**Dimensions and subdimensions of the scale**

**Planning**: Set of actions undertaken prior to the start of studying, through which the student organizes, anticipates, and establishes the necessary conditions for effective learning. This includes defining learning objectives, preparing the physical and virtual environment, managing time, selecting study strategies, and preparing materials and digital resources.

| Subdimension | Definition | Original version in Spanish<br><br>"Antes de comenzar mi estudio, yo..." | Reference translation in English<br><br>"Before I start studying, I..." |
|---|---|---|---|
| Learning purposes | Actions through which the student sets personal goals and reasons to guide and motivate their study. | Me digo a mí mismo que seré capaz de realizar la actividad con éxito. | I tell myself I'll be able to complete the activity successfully. |
| | | Busco una razón para que mi estudio sea importante. | I look for a reason to make my study important. |
| | | Me digo a mí mismo que soy capaz de comprender lo que me van a enseñar. | I tell myself I'm capable of understanding what I'm going to be taught. |
| | | Busco una razón para que mi estudio sea útil. | I look for a reason to make my study useful. |
| Study environment preparation | Actions taken by the student to organize the physical and virtual environment in which they will study. | Busco un sitio tranquilo para estudiar. | I look for a quiet place to study. |
| | | Busco un lugar sin distracciones para estudiar. | I look for a place without distractions to study. |
| | | Busco un espacio cómodo para estudiar. | I look for a comfortable place to study. |
| Time management | Actions undertaken by the student to organize the time to | Hago una lista detallada de las actividades académicas que necesito realizar. | I make a detailed list of the academic activities I need to complete. |

| | | | |
|---|---|---|---|
| | be devoted to academic activities. | Planifico mi tiempo para atender mis compromisos académicos. | I plan my time to attend to my academic commitments. |
| | | Hago un horario para organizar mi tiempo de estudio. | I make a schedule to organize my study time. |
| | | Planeo en qué orden realizaré mis actividades académicas. | I plan the order in which I'll do my academic activities. |
| Study strategy selection | Identification and selection of learning methods or techniques suited to the characteristics of the task and the student's prior experience. | Busco estrategias de estudio que puedan ayudarme a aprender más. | I look for study strategies that can help me learn more. |
| | | Evalúo cuál es la mejor forma de estudiar. | I evaluate the best way to study. |
| | | Pienso en qué estrategias de aprendizaje me han funcionado antes que sean similares a los que enfrentaré. | I reflect on learning strategies that have worked for me in similar types of studies to what I'll be facing. |
| Preparation of materials and digital resources | Actions carried out by the student to prepare and organize learning materials, as well as the technological tools and resources required for studying. | Me aseguro de contar con el software/programa adecuado para mi estudio (programa instalado, licencias, claves, etc.). | I verify I have the necessary study software (installed programs, licenses, passwords). |
| | | Considero el almacenamiento en la nube para respaldar y acceder a mis recursos en todo momento. | I consider cloud storage to back up and access my resources at all times. |
| | | Me aseguro de tener a mano todo el material que pueda necesitar antes de empezar a estudiar. | I make sure to have all the materials I might need on hand before starting to study. |
| | | Considero recursos en línea que puedan ser de utilidad para mi estudio. | I consider online resources that might be useful for my studies. |
| **Execution**: Encompasses the strategies and behaviors implemented by the student while carrying out academic activities, aimed at monitoring and regulating their own learning. It includes the use of personal, social, and external parameter comparison strategies to track progress, identify difficulties, and make real-time adjustments. | | | |
| Subdimension | Definition | Original version in Spanish | Reference translation in English |
| | | "Mientras realizo mi estudio, yo..." | "While I study, I..." |

| | | | |
|---|---|---|---|
| Personal strategies for self-monitoring | Individual behaviors to monitor progress, identify difficulties, and make adjustments to one's study approach. | Reviso mi lista de tareas por hacer. | I review my to-do list. |
| | | Ajusto mi forma de trabajo cuando me doy cuenta de que no está respondiendo a mis necesidades de estudio. | I adjust my way of working when I realize it's not meeting my study needs. |
| | | Busco material en línea que me ayude a comprender mejor los temas que estoy estudiando. | I look for online material that helps me better understand the topics I'm studying. |
| | | Reviso materias anteriores que me ayuden a estudiar. | I review previous subjects that help me study. |
| | | Hago ejercicios para comprobar que estoy aprendiendo. | I do exercises to make sure that I'm learning. |
| | | Me hago preguntas sobre la materia para saber si estoy aprendiendo. | I ask myself questions about the material to know if I'm learning. |
| Social strategies for self-monitoring | Interaction with peers to request, offer, or exchange academic support aimed at enhancing learning. | Comparto mis conocimientos con compañeros cuando domino un tema. | I share my knowledge with classmates when I master a topic. |
| | | Pido ayuda a mis compañeros cuando me doy cuenta de que no logro aprender. | I ask my classmates for help when I realize I'm not able to learn. |
| | | Contacto a mis compañeros para resolver dudas de mi estudio. | I contact my classmates to resolve study doubts. |
| | | Busco ayuda cuando me doy cuenta de que necesito apoyo. | I seek help when I realize I need support. |
| External parameters for self-monitoring | Comparison of one's own progress and outcomes with indicators of peers' performance and progress. | Reviso como avanzan mis compañeros en sus estudios para estimar mi propio avance. | I check how my peers are advancing in their studies to estimate my own progress. |
| | | Voy comparando mis aprendizajes con los de mis compañeros/as para evaluar si estoy aprendiendo. | I compare my learning with that of my classmates to assess if I'm learning. |
| | | Comparo mis calificaciones (notas) con las de mis compañeros | I compare my grades (scores) with those of my |

| | | | |
|---|---|---|---|
| | | para evaluar mi rendimiento. | classmates to evaluate my performance. |
| | | Comparo si las dificultades que experimento en mi aprendizaje son similares a las de mis compañeros. | I compare if the difficulties I experience in my learning are similar to those of my classmates. |
| **Assessment**: Refers to the actions taken by the student upon completing their study to evaluate their performance and outcomes. This includes self-assessment of the process and the strategies employed (self-judgment), as well as the use of self-motivation resources that support sustained effort and improvement in future learning. | | | |
| Subdimension | Definition | Original version in Spanish<br><br>"Cuando he terminado mi estudio, yo..." | Reference translation in English<br><br>"When I've finished studying, I..." |
| Self-judgment | Actions undertaken by the student to evaluate their study process and learning outcomes. | Busco espacios que cuenten con mejores condiciones (infraestructura, internet, equipamiento u otro) cuando evalúo que los utilizados fueron deficientes. | I look for spaces with better conditions (e.g., infrastructure, internet, equipment) when I assess that the ones I used were deficient. |
| | | Evalúo si el entorno para mi estudio fue el más apropiado. | I evaluate if my study environment was the most appropriate. |
| | | Evalúo si mi forma de estudio fue la más adecuada. | I evaluate if my study method was the most appropriate. |
| | | Evalúo si mi organización de actividades fue exitosa. | I assess if my activity organization was successful. |
| | | Evalúo si la planificación del tiempo fue la correcta. | I evaluate whether my time planning was correct. |
| | | Solicito retroalimentación para obtener una comprensión más clara de mi desempeño académico. | I request feedback to gain a clearer understanding of my academic performance. |
| | | Vuelvo a revisar el material de estudio para mejorar mi aprendizaje, aclarar dudas y/o corregir errores. | I re-review study material to improve my learning, clarify doubts, and/or correct mistakes. |

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| | | Evalúo si la(s) estrategia(s) de estudio que utilicé fueron las más adecuadas. | I evaluate whether the study strategy(ies) I used were the most appropriate. |
| | | Evalúo si obtuve la calificación (nota) que esperaba | I assess whether I obtained the score (grade) I expected. |
| Self-motivation | Strategies aimed at strengthening personal motivation, maintaining effort, and the willingness to continue learning. | Me auto felicito cuando he logrado mis metas de estudio. | I praise myself when I've achieved my study goals. |
| | | Me auto premio cuando he logrado un buen aprendizaje. | I reward myself when I've achieved good learning. |
| | | Interpreto mis fallos en mi estudio como una opción de mejora. | I interpret my study failures as an opportunity for improvement. |
| | | Aparto pensamientos negativos sobre mí mismo cuando no he logrado un buen aprendizaje. | I set aside negative thoughts about myself when I have not achieved good learning outcomes. |
| | | Me doy ánimo para continuar estudiando cuando no alcanzo las metas de aprendizaje que me he propuesto. | I encourage myself to keep studying when I fail to reach my learning goals. |