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Diseño y validación de una escala breve de estrategias de aprendizaje

Design and validation of a brief scale of learning strategies

Desenho e validação de uma breve escala de estratégias de aprendizagem

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Resumen

Introducción. El modelo por competencias imperante en las distintas instituciones educativas de nivel superior exige el desarrollo de la autorregulación en los alumnos, de modo que puedan ser los responsables de planear y ejecutar acciones para el logro de los aprendizajes. Una vía para alcanzar dicha meta es el conocimiento y aplicación de distintas estrategias de aprendizaje. Objetivo. Por ello, el presente estudio de tipo instrumental tuvo como propósito diseñar y evaluar las propiedades psicométricas de una escala de estrategias de aprendizaje. Método y materiales. Para tal fin, se creó la escala breve de estrategias de aprendizaje que fue sometida al análisis de expertos y después aplicada a una muestra de 1975 universitarios. Resultados. Tanto el análisis factorial exploratorio como el confirmatorio arrojaron una estructura de dos dimensiones, en las cuales fue preciso eliminar dos ítems para que los indicadores de ajuste fueran adecuados. La confiabilidad de los factores se obtuvo mediante tres criterios y todos evidenciaron la fiabilidad del instrumento. Conclusiones. Los resultados evidencian que se cumplió con el propósito del estudio

de dotar a la psicometría de un instrumento válido y confiable que permita examinar las estrategias de aprendizaje en estudiantes universitarios.

Palabras clave: estrategias de aprendizaje, diseño de instrumentos, autorregulación, autoaprendizaje.

Abstract

Introduction. The prevailing competency model in the different higher education institutions requires the development of self-regulation in students, where they are responsible for planning and executing actions to achieve learning. One way to achieve this goal is the knowledge and application of different learning strategies. Objective. For this reason, the present instrumental study had the purpose of designing and evaluating the psychometric properties of a scale of learning strategies. Method and material. For this purpose, the Brief Scale of Learning Strategies was created, which was carried out through expert analysis and later applied to a sample of 1,975 university students. Results. Both exploratory and confirmatory factor analysis showed a two-dimensional structure, requiring two items to be eliminated for the default fit indicators to be adequate. The reliability of the factors was obtained through three criteria and all evidenced the reliability of the instrument. Conclusions. The results show that the purpose of the study of providing the discipline of psychometry with a valid and reliable instrument that allows examining the learning strategies of university students was fulfilled.

Keywords: learning strategy, test design, self-regulation, self-learning.

Resumo

Introdução. O modelo baseado em competências que prevalece nas diferentes instituições de ensino superior exige o desenvolvimento da autorregulação nos alunos, para que estes possam ser responsáveis pelo planejamento e execução de ações para alcançar a aprendizagem. Uma forma de atingir esse objetivo é o conhecimento e aplicação de diferentes estratégias de aprendizagem. Mirar. Portanto, o objetivo deste estudo instrumental foi projetar e avaliar as propriedades psicométricas de uma escala de estratégias de aprendizagem. Método e materiais. Para o efeito, foi criada a escala breve de estratégias de aprendizagem, que foi submetida à análise de peritos e posteriormente aplicada a uma amostra de 1975 estudantes universitários. Resultados. Tanto a análise fatorial exploratória quanto a confirmatória produziram uma estrutura bidimensional, na qual foi necessária a eliminação de dois itens para que os indicadores de ajuste fossem adequados.

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A confiabilidade dos fatores foi obtida através de três critérios e todos evidenciaram a confiabilidade do instrumento. Conclusões. Os resultados mostram que o objetivo do estudo de dotar a psicometria de um instrumento válido e confiável que permita examinar estratégias de aprendizagem em estudantes universitários foi alcançado.

Palavras-chave: estratégias de aprendizagem, desenho de instrumentos, autorregulação, autoaprendizagem.

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Introduction

In recent years, thanks to globalization and industrial development, the competency system has become essential, allowing greater competitiveness and performance in workers (Bemmami *et al.* , 2021), both in organizations and in educational institutions. McClelland was the first to introduce the concept of *competence* in 1973, which he defined as "personal habits that encourage more effective or superior work performance" (Bemmami *et al.* , 2021). Recently, Paquette *et al.* (2021) define competencies as "the ability of people to carry out a skill with a certain level of performance by applying one or more knowledge" (p. 1).

Within the educational process and knowledge management, the acquisition of new skills is one of the central objectives. Ministries of education, school boards and teacher training institutes use competency profiles to define the objectives of school programs. Regarding the work and organizational sphere, they also tend to consider the skills of their staff as their main asset (Paquette *et al.* , 2021).

The competency-based system has been found useful at different times and places in the history of education. In the United States of America, it was taken as an objective of teacher training from the 1970s, while in the United Kingdom this idea began to be used from 1980, mainly in higher education and for teacher training; On the other hand, in countries like Germany, only in the year 2000, they began to focus on the concept of competencies in education (Glaesser, 2019).

The use of skills in the academic field favors learning, especially self-learning, particularly in higher education, regardless of the discipline or career area in which it is developed. For this reason, competencies can be considered generic, since they are used in various situations (Tuononen and Parpala, 2021). Competency models favor self-directed, self-regulated and autonomous learning on the part of the student. This leads the student to learn continuously throughout life, which promotes a completely active posture in their learning process. Consequently, the need arises for university training to focus on the social context and be more

committed to practical training, since this prepares university students for their professional life, where the skills acquired during their training will be relevant (López et al . *al.* , 2016).

That students are able to learn in a self-regulated manner is key in acquiring skills so that they can then control their behavior, motivation and cognition to reach a goal. In effect, by self-regulating their behavior, the student manages their time and the resources with which they will work; In addition, you can have control of motivational factors, self-efficacy, goal function, as well as control of your emotions. Finally, self-regulation of cognition refers to the control of strategies that are necessary to achieve the expected learning (Kayacan and Sonmez Ektem, 2019).

The mastery and application of these strategies will provide the student with options that lead to the understanding of the materials, as well as their transfer to other contexts, which is essential in competency models. In higher education, this transfer is beneficial because it, in turn, facilitates successful job placement. Panadero and Tapia (2014) state that "the activation of appropriate learning strategies depends on self-regulation, this being a fundamental capacity for students to have academic success in both primary, secondary, and higher education" (p. 450).

In this sense, it has been investigated how the learning strategies used by students impact academic performance and performance. For example, Salazar and Heredia (2019) found that students with high and medium academic performance used resource management and elaboration strategies, respectively, while those with low performance were not correlated with any type of strategy. . In this sense, as it is considered a key factor for learning, it is important to know the mastery and application of these strategies by students.

Based on the above, in this study a review was made of various instruments that measure the frequency of use of various learning strategies from different approaches (see table 1). Some of them evaluate the presence of certain thoughts or actions that lead to learning, others focus on specific strategies and some on processes. The main characteristic of these instruments is that they contain many dimensions and items, which compromises their reliability and validity, since when applied in different contexts and populations they are not usually grouped in the same way and report low reliability indices. Such is the case of the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich *et al.* (1986), the Questionnaire for the Evaluation of Learning Strategies of University Students (CEVEAPEU) by Gargallo *et al.* (2009), the Learning Strategies Scale (ACRA) by Román and Gallego (1993), the Learning Strategies Questionnaire for University Students (CEA-U) by Cabrera *et al.* (2007), the Self-Employment Strategies Questionnaire (CETA) by López Aguado (2010), the Strategic Information Processing Evaluation Questionnaire

for University Students (CPEI-U) by Castellanos *et al.* (2011) and the Scale of Strategies for Meaningful Learning by Méndez and Segura (2022).

The aforementioned instruments have evidence of construct validity and reliability of their design, and their items provide sufficient information about the construct to be evaluated, which demonstrates their content validity. However, they are not ideal in today's time, where speed and lack of concentration prevail in most of the activities carried out by adolescents and young people.

Due to the above, the lack of a brief and quantitative instrument that measures the action of carrying out or not carrying out a specific activity that leads to learning was detected. Having an instrument with such characteristics, that is, one that measures the learning strategies that collaborate with the development of competencies in university students, is a global need.

Therefore, the present study aims to contribute to psychometrics by producing an instrument with statistical evidence of validity and reliability, which specifically measures those strategies that lead to the elaboration and organization of information, which is the basis for achieving significant learning (Pozo *et al.* , 1990, 1994), that is, deliberately excluding repetition strategies, which do not lead to the understanding of the information.

Likewise, in this way greater coverage is allowed as it is not about specific behaviors of a single competence, but rather the profile of university students is affected. The importance of the instrument, therefore, lies in the importance of the construct, since only those students who know and apply the learning strategies will be able to continue learning, even if they graduate from university, and will be able to produce knowledge and apply it without needing of a teacher's approval.

The number of items in an evaluation instrument plays an important role in the quality and veracity of the participants' responses, so the characteristic of being brief and providing easily interpreted information accessible to any teacher, without the need for it to be expert on the subject, would provide greater coverage and enhance the learning validation exercise, since by applying and interpreting it, any teacher will be able to choose whether or not to train their students in learning strategies, before starting with the contents of the school year . which would ensure, in a certain way, the learning of its students.

Thus, university students will benefit from being able to provide feedback to their self-regulation learning process. In this sense, it can be stated that autonomously monitoring learning is considered an essential competence for students to achieve their academic goals (Zheng *et al.* , 2019).

This instrument—whose results were shared with the sample, that is, the university students who participated in the study—has a positive impact locally, since it allows us to determine that the learning processes take place in the educational institution where the research was carried out.

Finally, it can be stated that the development of measurement instruments is of relevance in the field of academic production that contributes to research, in this case, related to strategic and self-regulated learning, and in its level of application of knowledge for the educational management, where decision making as a consequence of the adequate evaluation of the variables that affect learning.

In this scenario, the following objectives were set: 1) design a brief scale of learning strategies; 2) evaluate the construct validity of a brief learning strategies scale, and 3) examine the reliability of a brief learning strategies scale. Then, taking into account the close relationship between the *learning strategies* and *self-regulation constructs* , a fourth objective was proposed: to examine the relationship between the learning strategies scale and the Inventory of Self-regulated Learning Processes (Rosário *et al.* , 2007) .

Learning strategies

This section offers the conceptualization of the constructs of the present study. Simply put, learning strategies are those sequences of actions that are performed intentionally to achieve a learning objective. Two pioneering definitions of learning strategies are those presented by Castañeiras *et al.* (1999) and Weinstein and Mayer (1986). Castañeiras *et al.* They define them as "integrated sequences of procedures or activities that are chosen with the deliberate purpose of facilitating the acquisition, storage and use of information" (Nissbet and Shucksmith, cited by Castañeiras *et al.* , 1999, p. 39). For their part, Weinstein and Mayer (1986) state that they can be defined as "behaviors and thoughts that a learner uses during learning with the intention of influencing their encoding process" (p. 315).

To these two definitions, Monereo *et al* . (1994) provides another that encompasses many of its characteristics in the educational field, since it presents them as " decision-making processes (conscious and intentional) in which the student chooses and recovers, in a coordinated manner, the knowledge he needs to complete a certain demand or objective, depending on the characteristics of the educational situation in which the action occurs" (p. 14).

Classification of learning strategies

As could be seen, there is no unanimity regarding the definition of learning strategies, so the classifications that can be found in the bibliography are varied. Various authors have provided characterizations of learning strategies, of which Pozo *et al.* (1990, 1994) is one of the most accepted. These authors indicate that they can be distinguished into three types.

The first type of strategies found are review strategies, which consist of associative learning based on frequent practice. It is usually quite useful for learning already established, meaningless and arbitrary content. Within these strategies, not only the simple review technique is used, but others such as taking notes and underlining are also included.

The second type of strategies are the elaboration strategies where everything that consists of coding, translation or interpretation procedures of material is integrated from an external system of relationships that facilitates learning it more easily. It includes any action taken for this purpose.

Finally, there is the third type of strategies, which are organizational strategies. These aim to search for an internal structure or organization in the material that is being learned that gives it its own meaning. As an example of techniques that integrate this type of strategies are those that involve the hierarchization and classification of information, in addition to thinking and problem-solving skills.

Instruments on learning strategies

The ideal way to make decisions about the insertion into the curriculum or tutoring programs of universities of topics related to learning strategies is their assessment. Measuring the use of learning strategies is essential for making decisions about student learning. As Muñiz and Fonseca-Pedrero (2018) mention, “tests are the measurement instruments most used by psychologists to obtain data about people's behavior” (p. 7).

Although there are numerous instruments that analyze the use of learning strategies at the university level, Méndez and Segura (2022) present a detailed analysis of some of these (table 1).

Table 1. Instruments that measure the *learning strategies construct*

Instruments	Dimensions, scales or subscales		Items	Sample
Scale of Strategies for Significant Learning (Méndez and Segura, 2022)	Conceptual maps		7	890 university students
	Guided discussion		5	
	Box plot		4	
	Synoptic table		4	
	Positive, negative and interesting		6	
	Graphic representations (concept maps and key diagram)		5	
	Objectives and intentions		3	
	Summary		3	
Strategic Information Processing Evaluation Questionnaire for University Students (CPEI-U) (2011) (Castellanos *et al.* , 2011)	Positive attitude towards studying		7	442 university students
	Selection and use of strategies.		18	
	Strategic and personal control.		12	
	Strategic metaknowledge and correction of distractors.		22	
Self-Employment Strategies Questionnaire (CETA) (López Aguado, 2010)	Expansion strategies		9	805 university students
	Collaboration strategies		eleven	
	Conceptualization strategies		8	
	Planning strategies		10	
	Exam preparation strategies.		6	
	Participation strategies		6	
Learning Strategies Questionnaire for University Students (CEA-U) (Cabrera *et al.* , 2007)	Motivational strategies		27	1105 university students
	Cognitive strategies		22	
	Metacognitive strategies		8	
Learning Strategies Scale, abbreviated for university students (ACRA) (De la Fuente y Justicia, 2003)	Cognitive and learning control strategies		25	866 university students
	Learning support strategies		14	
	Study habits		5	
ACRA Learning Strategies Scale (Román and Gallego, 1993)	Acquisition		7	Middle and high school students
	Coding		13	
	Recovery		4	
	Processing support		9	
Questionnaire for the Evaluation of Learning Strategies of University Students (CEVEAPEU) (Gargallo *et al.* , 2009)	Affective, support and control (or self-management) strategies scale	Motivational Strategies	twenty	1672 students university students
		Affective Components	8	
		Metacognitive Strategies	fifteen	
		Context Control, Social Interaction and Resource Management Strategies	10	

	Strategies related to information processing	Search and Selection and Information Strategies	8	
		Information Processing and Use Strategies	27	
Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich *et al.* , 1986).		Intrinsic Orientation Goals	4	380 university students
		Extrinsic Orientation Goals	4	
		Task Value	6	
		Control Beliefs	4	
		Self-efficacy for Learning	8	
		Anxiety	5	
	Learning strategies scale	Repetition	4	
		Elaboration	6	
		Organization	4	
		Critical thinking	5	
		Metacognitive Self-Regulation	12	
		Time and Environment Management	8	
		Effort Regulation	4	
		Peer Learning	3	
		Search for Help	4	

Source: Adapted from Méndez and Segura (2022)

As mentioned above, the instruments presented are adequately designed and validly and reliably measure the *learning strategies construct* , but it is observed that they have a large number of items and dimensions.

Self-regulated learning

One of the greatest implications of using learning strategies is their relationship with self-regulation. The measurement of learning strategies requires the measurement of self-regulation, since the use of learning strategies in an autonomous and unguided manner can lead the student to regulate their own learning processes. Therefore, in this study it was decided to measure both constructs.

In this regard, various researchers and educators agree that the ability to self-regulate learning is important for academic success (Raković *et al.* , 2022). When reviewing the literature, it has been found that self-regulation gives favorable and significant results to learning. For students to have a good result as in the studies carried out, it is necessary that their role be active in the teaching process in its various dimensions and approaches (Kayacan and Sonmez Ektem, 2019). Training students in strategies helps them to be more active in their learning process (Arcoverde *et al.* , 2022) and, consequently, to be able to self-regulate.

Self -regulation of learning can be understood as "the process through which the student configures his activity and organizes his environment in an attempt to achieve the objectives that are imposed on him, or that are imposed, in the face of an academic activity, in an autonomous and motivated manner. " (Hernández and Camargo, 2017, p. 147). For Castro *et al.* (2021) self-regulation is mainly based on the use of learning strategies, as well as their activation when working to achieve the academic goals they have set for themselves.

Phases of the Zimmerman model

Within Zimmerman's model there are three cyclical phases in which the aforementioned characteristics can be found and explain the process of self-regulated learning (Zimmerman, 2000).

First phase: forecast

This is the initial phase, that is, when the student faces the task for the first time and begins to carry out two types of activities. The first is the analysis of the task, that is, when the student begins to fragment the activity into small steps to establish the objectives, taking into account the evaluation criteria, that is, the standards under which the activity will be evaluated and the level of perfection that the student wants to achieve in their task; Then, it is necessary to plan the strategies that will be used to achieve the objectives (Panadero and Tapia, 2014; Zimmerman and Moylan, 2009).

As the second activity of the initial phase, all motivational beliefs and personal variables are considered, fundamental aspects for the activation of the self-regulation cycle, such as self-efficacy, results expectations, goal orientation and the value of the task (Panadero and Tapia, 2014; Zimmerman and Moylan, 2009).

Second phase: execution

Within this phase the activity is carried out. Here it is of great importance to maintain concentration and use the appropriate strategies to increase interest and achieve your goals. For this, the student can use two processes: self-observation and self-control (Panadero and Tapia, 2014; Zimmerman and Moylan, 2009).

Third phase: self-reflection

In this phase, the student must evaluate their work and explain the reasons for the results obtained, which could influence their motivation and future self-regulation through two processes: self-judgment and self-reaction (Panadero and Tapia, 2014; Zimmerman and Moylan, 2009).). This entire process is cyclical and feeds back, in this way the student can take into account the result of the activity when planning the next one (Zimmerman, 2011).

As could be noted, for the first two phases of self-regulation, knowledge of the learning strategies is necessary, as well as their correct application, since only then will one be able to plan the actions of activities to be carried out and the appropriate time to do them. Therefore, its measurement with valid and reliable instruments is essential.

Method

For more than 30 years, educational systems have focused efforts on improving academic performance, which has forced them to move towards an approach focused on learning, which can be seen today. Therefore, the purpose of education has been aimed at equipping students with learning strategies that lead them to regulate their learning and generate knowledge autonomously. Due to this, and with the intention of knowing the current state of learning strategies in students, the Brief Scale of Learning Strategies was created for university students.

Based on the above, this quantitative study had the following objectives: 1) design a brief scale of learning strategies; 2) evaluate the construct validity of a brief scale of learning strategies; 3) examine the reliability of a brief learning strategies scale. Then, taking into account the close relationship between the *learning strategies* and *self-regulation constructs* , a fourth objective was proposed: to examine the relationship between the learning strategies scale and the inventory of self-regulation learning processes (Rosário *et al.* , 2007) .

Design

This is an instrumental (Montero and León, 2005) and correlational study (Hernández-Sampieri and Mendoza, 2018), since it specified the design of an instrument and the relationship between two variables: learning strategies and self-regulation.

Participants

The intentional or convenience sample was made up of 1975 university students from northern Mexico, of which 46% indicated they were male, 53.5% female, and 0.4% preferred not to respond. The mean age was □= 20.9 years, the Md = 20 years and the mode was 17 years; The standard deviation was 2.991, with a maximum value of 44 years and a minimum of 15 years. Regarding the modality in which the students were taking classes, it was found that 94.3% were online, 7% in person and 4.5% in a hybrid system. Of all the participants, 63.9% stated that they did not work and 36.1% mentioned that they did. The sample was divided into two parts randomly for the evaluation of its validity and reliability. Sample number one was used for exploratory factor analysis (EFA) and sample two for confirmatory factor analysis (CFA).

Instruments

Brief scale of learning strategies (EBEA)

The brief scale of learning strategies (EBEA) was designed, composed of 11 positive Likert-type items, with frequency response options (always, almost always, sometimes, almost never and never) with which the learning strategy is carried out. The range of items was 5 to 1.

Inventory of self-regulated learning processes (Rosário *et al.* , 2007)

This is a Likert-type scale of 12 positive items, grouped into three dimensions, which are the three phases of the self-regulated learning process: planning, execution and evaluation (Rosário *et al.* , 2007; Zimmerman, 2000). The response options range from always to never, ranging from 5 to 1. When the instrument was applied, a Cronbach's alpha index α= .645 was obtained in planning (items 1, 5, 9, 12), α= . 682 for execution (items 3, 6, 8, 10) and α= .721 for evaluation (items 2, 4, 7, 11).

Procedure

Carretero-Dios and Pérez (2005) were applied .

Conceptual delimitation of the evaluated construct

At first, an extensive bibliographic review was carried out on the construct *of learning strategies* , taking Pozo *et al. as a theoretical framework of reference.* (1990, 1994).

were written that evidenced the application of certain specific learning strategies. When writing the items, the criteria stated by Edwards (1983) were taken into account.

Assessment of the content validity of the items

Next, the items were submitted to the judgment of three experts who assessed their content validity. As a result of the experts' comments, modifications were made and the pilot scale was designed.

Instrument application

Prior to the application, informed consent was requested from the students. A total of 1975 instruments were applied to subjects (with the characteristics already described in the participants section) in a self-administered manner with Google Forms. The application was carried out digitally and in groups, during the students' online classes. Participants were told that freedom from coercion would be present at all times and they could decide not to answer the instrument whenever they wanted. All data were collected in accordance with the principles of privacy and confidentiality, as well as informed consent of the Declaration of Helsinki.

Once the instrument was applied, the responses were coded. Because the application was made with *purpose*- designed *software* , there were no missing values. Once the database was obtained, the subjects were randomly distributed into two samples.

Construct validity analysis

To evaluate the construct validity of the EBEA performed an EFA with sample number one. The unweighted least squares extraction method was applied. The rotation method used was varimax and was carried out with the SPSS statistical package, v24.

The CFA was carried out in the second sample, using the statistical package AMOS v24 and JASP, version 0.16.3, with the objective of exploring the goodness of fit of the two-dimensional model. The CFA was performed with the maximum likelihood estimation method (Hair *et al.* , 2014). The goodness-of-fit values determined were by chi-square (χ^2), however, considering that χ^2 is sensitive to sample size (Fujikoshi, 2000), the relative chi-square was reported (χ^2/df ; Bollen, 1998), which expresses an adequate model fit by presenting values

between two and three, or more flexibly, with values ≤ 5 (Carmines and McIver, 1981). The goodness-of-fit index (*GFI*), the adjusted goodness-of-fit index (*AGFI*), the comparative fit index (*CFI*), the non-normative fit index (*NNFI*), the root mean square error of approximation (*RMSEA) were calculated.*), the standardized root mean square residual (*SRMR*) and the average variance extracted (*AVE*). The values indicative of good fit were used, which are in the case of the *GFI* , *AGFI* and *NNFI* > .90, *RMSEA* and *SRMR* < .08 and *AVE* <.5 (Hu and Bentler, 1999). In relation to the factor loadings (λ 's *)* , values ≥ *.40* were considered adequate (MacCallum *et al.* , 1999).

Reliability assessment

Once the factor structure of the scale was determined, reliability indices were obtained through a reliability analysis using three criteria: Cronbach's alpha coefficient (Cronbach, 1951), McDonald's omega (Hair *et al.* , 2010) and the inter-item correlation (Padilla and Divers, 2016). De Vellis (2003) indicates that below 0.60 reliability is *unacceptable* , from 0.60 to 0.65 is *undesirable* , between 0.65 and 0.70 *minimally acceptable* , from 0.70 to 0.80 *respectable* and from 0.80 to 0.90 *very good* , but there is a consensus that Values closer to 1 indicate greater reliability. In the case of the McDonald's omega test, the expected values must be greater than .7 (ω > .7) and in the inter-item correlation greater than .3 (CII>.3).

Relationship of learning strategies with self-regulation

Descriptives were obtained by item and by dimension from the EBEA and the inventory of self-regulated learning processes. To contrast the means of the different dimensions, a "standardized" value was obtained by dividing the means by the number of items; Thus, the values of all dimensions range between 1 and 5, which makes comparison easy. Next, to provide evidence of validity in relation to other variables, the different dimensions of both instruments were correlated, as well as their total score.

Results

From the theoretical review and expert judgment, a scale of 11 items was obtained, classified into two dimensions: elaboration and organization.

Analysis of psychometric properties

To evaluate the psychometric properties, *construct validity* and *reliability* , it initially began with an EFA. Table 2 shows the results of the analysis of the viability of confirmatory factor analysis, where the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's sphericity test confirm it. To be acceptable, the KMO index must be greater than 0.5 (Kaiser, 1970) and with regard to the data obtained, the viability of the factor analysis is observed.

Table 2. KMO and Bartlett test

Kaiser-Meyer- Olkin measure of sampling adequacy .		.845
Bartlett's test of sphericity	Approximate chi-square	279,.947
	Gl	55
	Next.	,000

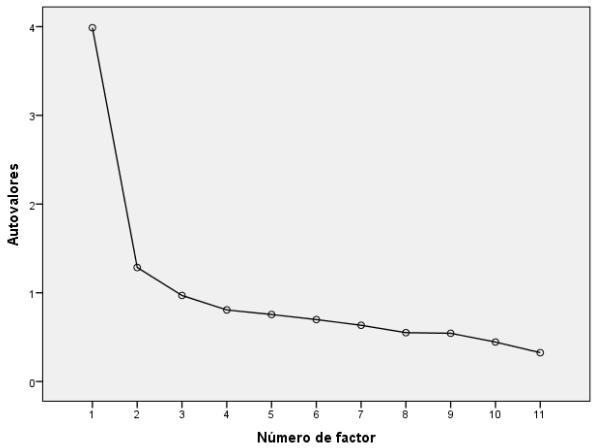
Source: self made

Similarly, Bartlett's test of sphericity was statistically significant (p <.05), which led to the rejection of the hypothesis of independence of the variables and it was deduced, here too, that it was appropriate to continue EFA.

K1 rule was used as a basis. (eigenvalues greater than 1) and the sedimentation graph of Cattell (1966). In both, the presence of two factors was verified (see Figure 1), which will be called *organization strategies* and *preparation strategies* .

The eigenvalue for the first factor was 3.988 and for the second factor it was 1.285; On the other hand, the percentage of variance explained for the first factor was 36.254% and for the second factor it was 11.684.

Figure 1. Scree plot same for the selection of factors



Source: self made

As seen in Table 3, the unweighted least squares extraction method with varimax rotation yielded a factorial structure of two factors, which will be called *organizational strategies* and *elaboration strategies* .

Table 3. Matrix of rotated factors for the EBEA

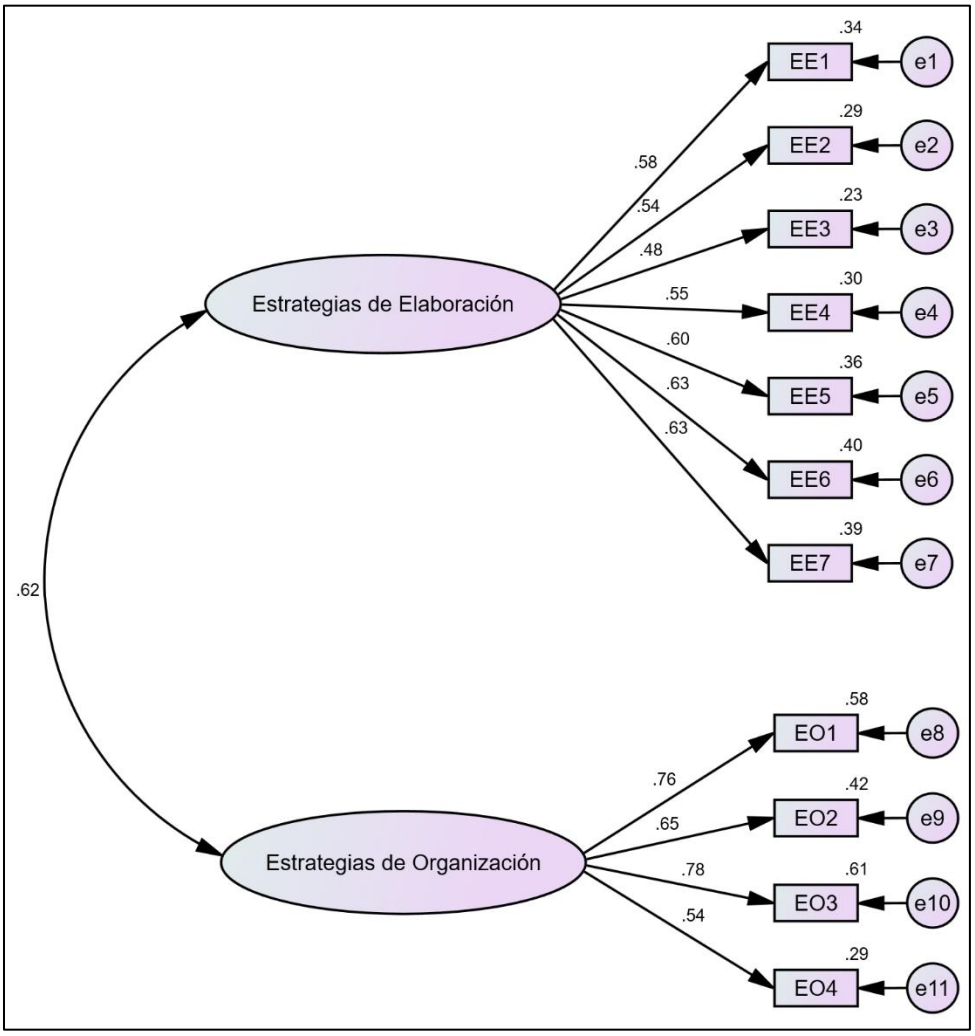
	Factor	
	1	2
1. I ask myself questions to see if I understood what I am studying. (EE1)	.524	
2. When studying I make a diagram or drawing of the information to understand better. (EO1)		.688
3. When I am studying and I have questions, I ask someone to explain to me. (EE2)	.482	
4. If I don't understand what the teacher explains, I ask him. (EE3)	.404	
5. When I study I repeat several times what I have to learn. (EE4)	.635	
6. When I study I underline the most important things. (EE5)	.615	
7. When I have to study I make summaries. (EO2)		.411
8. I relate new information I learn with what I already know. (EE6)	.572	
9. When I study I make concept maps or mental maps. (EO3)		.883
10. When I am studying a topic that I do not understand, I go back to studying previous topics to understand it. (EE7)	,543	
11. When I have to learn a series of events that happened on certain dates (such as the dates of important events in a revolution) I use timelines. (EO4)		.425

Note. Factor 1= Preparation Strategies; Factor 2= Organization Strategies

Source: self made

Once the factor structure was obtained empirically, it was confirmed using CFA. Figure 2 shows a first structure of the scale that was generated in the AMOS v.24 package as part of its validation.

Figure 2 . First two-factor structure of the EBEA



Source: self made

As seen in Figure 2, each of the 11 items of the EBEA were loaded into two latent variables that represent the two dimensions of the scale. Table 4 shows the indicators of goodness of fit and validity of the instrument. In relation to the values found, it can be argued that the scale has adequate validity in 6 of the 8 indicators presented (Jackson *et al.* , 2009; Newsom, 2020). Only the non-normalized fit index (*NNFI* > .90) and the average variance extracted (*AVE* <.5) did not reach optimal indices (Hair *et al.* , 2010; Hu and Bentler, 1999). The standardized factor loadings (λ 's) for the two-factor model were adequate, both in the *elaboration strategies factor* (item EE1=.58, EE2=.54, EE3=.48, EE4=.55, EE5=. 60, EE6=.63, EE7=.63) as in the *organizational strategies factor* (EO1=.76, EO2=.65, EO3=.78 AND EEO=.54).

Table 4. Goodness-of-fit indicators of the first structure of the EBEA

Instrument	X^2 /gl	*GFI*	*AGFI*	*NNFI*	*CFI*	*RMSEA*	*SRMR*	*bird*
Brief scale of learning strategies	6,433	.954	.929	.896	.919	.074	.048	.383

Note. X^2 */Gl* = Relative Square Chi, *GFI* = Adjusting goodness index, *AGFI* = adjusted adjustment goodness index, *NNFI* = Non -standardized adjustment index, *CFI* = Comparative adjustment index, *RMSEA* = Average approximation quadratic error, *SRMR* = Standardized root mean square residual, *AVE* = Average variance extracted.

Source: self made

In relation to the reliability indices of the scale, Table 5 shows the values of 3 criteria for the 2 factors. According to the results, it can be considered that both factors are reliable in measuring the elaboration and organization strategies for the Cronbach's alpha indicators ($\alpha > .7$) in accordance with De Villes (2003); McDonald's omega ($\omega > .7$) according to Cortina (1993); and inter-item correlation (CII>.3) in accordance with Padilla and Divers (2016).

Table 5. Internal consistency indicators of the first structure of the EBEA

Instrument	α	ω	*IIC*
Brewing strategies	0.771	0.772	0.330
Organization strategies	0.779	0.772	0.459
Note . α = Cronbach's Alpha , ω = McDonald's Omega, *CII* = Inter-item correlation.			

Source: self made

In order to improve the adjustment indicators, a second structure was obtained by eliminating items EE2 and EE5 (see figure 3). In this new structure all the adjustment indicators were adequate, as shown in table 6.

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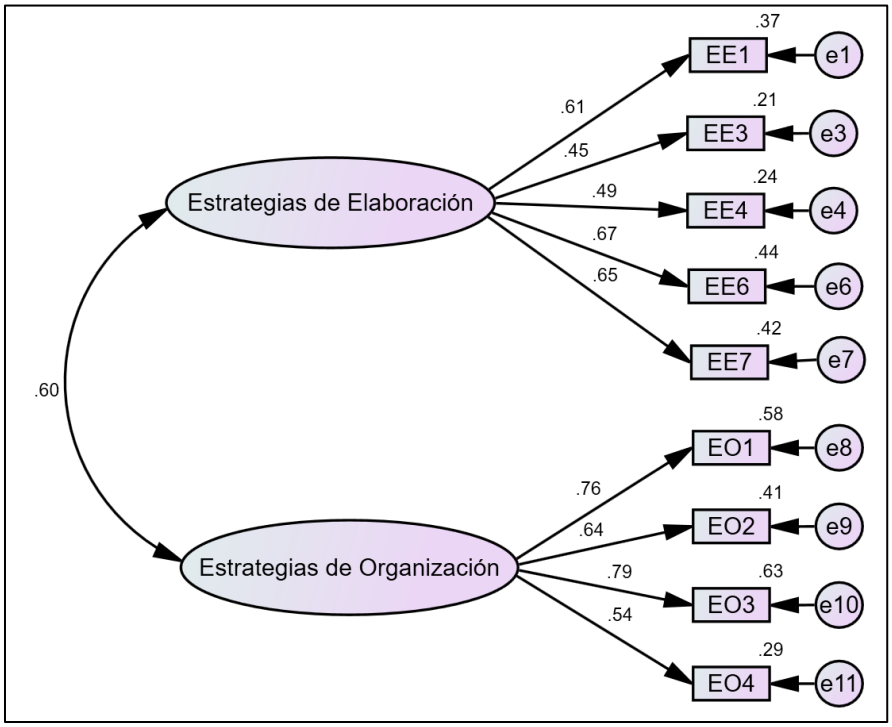
Figure 3 . Second three-factor structure of the EBEA



Source: self made

Table 6. Goodness-of-fit indicators of the second structure of the EBEA

Instrument	X^2/gl	*GFI*	*AGFI*	*NNFI*	*CFI*	*RMSEA*	*SRMR*	*bird*
Learning strategies	3,918	.979	.963	.951	.965	.054	.033	.399

Note. X^2/Gl = Relative Square Chi, *GFI* = Adjusting goodness index, *AGFI* = adjusted adjustment goodness index, *NNFI* = Non -standardized adjustment index, *CFI* = Comparative adjustment index, *RMSEA* = Average approximation quadratic error, *SRMR* = Standardized root mean square residual, *AVE* = Average variance extracted.

Source: self made

Again, the reliability of the factors of the three mentioned criteria was obtained: Cronbach's alpha, McDonald's omega and the inter-item correlation. As indicated in Table 7, the internal consistency indicators were adequate.

Table 7 . Internal consistency indicators of the second structure of the EBEA

Instrument	*α*	*ω*	*IIC*
Brewing strategies	0.702	0.704	0.327
Organization strategies	0.779	0.772	0.459

Note . *α* = Cronbach's Alpha , *ω* = McDonald's Omega, *CII* = Inter-item correlation

Source: self made

Relationship between EBEA and the inventory of self-regulation processes

Descriptives of the EBEA and the Inventory of self-regulation processes

Before correlating both instruments, descriptive statistics were obtained by item, dimension and totality of each instrument (see table 8). It is necessary to mention that the values obtained in the means in each dimension were divided by the number of items to obtain a "standardized" value that would allow comparison between dimensions.

The average values indicate that in the EBEA the *development strategies dimension* occurs more frequently than the *organization strategies dimension* . For its part, in the *inventory of self-regulation learning processes the scores were similar, with the execution* dimension scoring a little higher . The highest standard deviation was located in the EBEA *preparation strategies* .

Table 8 . Descriptives of the EBEA and the inventory of self-regulation processes

	□	DT	g_1	ETg_1	g_2	ETg_2	min	Max
EBEA	31.63	6.26	-.121	.055	-.089	.110	12	Four. Five
Brewing strategies	19.07 (3.81)	3.51	-.406	.055	-.051	.110	7	25
1. I ask myself questions to see if I understood what I am studying.	3.72	1.08	-.528	.055	-.361	.110	1	5
4. If I don't understand what the teacher explains, I ask him.	3.49	1.14	-.290	.055	-.725	.110	1	5
5. When I study I repeat several times what I have to learn.	4.05	.99	-.849	.055	.146	.110	1	5
8. I relate new information I learn with what I already know.	4.01	.96	-.768	.055	.145	.110	1	5
10. When I am studying a topic that I do not understand, I go back to studying previous topics to understand it.	3.81	1.03	-.546	.055	-.319	.110	1	5
Organization strategies	9.37 (2.34)	3.07	-.075	.055	-.610	.110	3	fifteen
2. When studying I make a diagram or drawing of the information to understand better.	3.25	1.22	-.199	.055	-.842	.110	1	5
7. When I have to study I make summaries.	3.27	1.27	-.175	.055	-.980	.110	1	5
9. When I study I make concept maps or mental maps.	2.85	1.26	-.155	.055	-.931	.110	1	5
11. When I have to learn a series of events that happened on certain dates (such as the dates of important events in a revolution) I use timelines.	3.19	1.24	-.163	.055	-.910	.110	1	5
Inventory of self-regulation processes	45.16	7.90	-.349	.055	-.070	.110	16	60
Planning	15.03 (3.75)	2.95	-.455	.055	.120	.110	4	twenty
1. I make a plan before I start doing written work. I think about what I'm going to do and what I need to achieve it.	3.86	1.07	-.724	.055	-.128	.110	1	5
5. I am sure that I am capable of understanding what they are going to teach me and that is why I think I will have good grades.	3.97	.89	-.589	.055	-.051	.110	1	5
9. I establish specific academic objectives for each subject.	3.53	1.07	-.384	.055	-.409	.110	1	5

12. Before starting to study, I check if I have everything I need: dictionaries, books, pencils, notebooks, photocopies, so that I am not always interrupting my study.	3.68	1.19	-.551	.055	-.682	.110	1	5
Execution	15.36 (3.84)	2.82	-.442	.055	.086	.110	4	twenty
3. When I study, I try to understand the subjects, take notes, make summaries, solve exercises, ask questions about the content.	3.79	.95	-.398	.055	-.465	.110	1	5
6. I stick to my study schedules, and make small changes whenever necessary.	3.73	1.01	-.415	.055	-.448	.110	1	5
8. While I'm in class or studying, if I get distracted or lose track, I usually do something to get back on task and achieve my goals.	3.72	.97	-.448	.055	-.214	.110	1	5
10. I am looking for a quiet place where I can concentrate to study.	4.12	1.01	-1.04	.055	.475	.110	1	5
Assessment	14.76 (3.69)	3.16	-.398	.055	-.117	.110	4	twenty
2. After finishing a midterm/final exam, I review it mentally to know where I made my successes and mistakes to get an idea of the grade I will have.	3.82	1.15	-.663	.055	-.377	.110	1	5
4. When I receive a grade, I usually think about specific things I need to do to improve my performance.	3.84	.96	-.546	.055	-.210	.110	1	5
7. I save and analyze corrections from written assignments or midterm tests to see where I went wrong and know what I need to change to improve.	3.71	1.06	-.524	.055	-.341	.110	1	5
11. I compare the grades I get with the objectives I had set for that subject.	3.39	1.15	-.335	.055	-.596	.110	1	5

Note. Standardized value in parentheses; DT=Standard Deviation; g_1 =Asymmetry; g_2 =Kurtosis; ET g_1 = Typical error of Asymmetry; ETg_2 = Standard error of Kurtosis

Source: self made

As can be seen, the asymmetry that occurs both in the different items and in dimensions of both instruments is negative, which indicates that the majority of the values are to the left of the mean. For its part, kurtosis—characterized by indicating whether there is relative elevation or flattening of a distribution—compared to the normal distribution, being positive, indicates a relatively high distribution, while a negative kurtosis indicates a relatively flat distribution. In the

case of the total values of EBEA and its dimensions, as well as in the entire inventory of self-regulation learning processes and its *evaluation dimension* , a flat (platykurtic) distribution is presented. The opposite is true for the *planning* and *execution dimensions* , whose value is positive, indicating a relatively high distribution (mesokurtic). This means that in the *planning* and *execution dimensions* the majority of scores are close to the mean, which is consistent with the fact that they are the dimensions with the lowest standard deviation.

Correlation between EBEA and the inventory of self-regulation processes

Due to the extensive relationship between the *learning strategies* and *self-regulation constructs* that the theoretical and empirical reference reports, the correlation of the EBEA with the inventory of self-regulation processes was obtained. Table 9 shows a broad correlation between the dimensions of both scales, of which the strongest correlation is between preparation strategies and planning. Furthermore, as can be seen, all correlations are significant at the .01 level and positive.

Table 9. Relationship between EBEA and the inventory of self-regulation processes

	Inventory of self-regulation processes		
Brief scale of learning strategies	Planning	Execution	Assessment
Brewing strategies	.572 **	.570 **	.537 **
Organization strategies	.404 **	.409 **	.400 **

Note. * *=Significant correlation at the .01 level

Source: self made

Discussion

The present study had special interest in the *learning strategies construct* as a central part in the training of students, since it is considered to be the fastest way to achieve self-regulation. Therefore, the contribution of the research presented here is to provide those interested in educational psychology with a brief, valid and reliable instrument that measures the frequency of use of certain specific strategies.

Related to the above , the first objective was raised that focused on designing a scale of learning strategies. As a result of the theoretical referential framework, a scale composed of 11 items was developed that was subjected to expert judgment, which resulted in the Brief Scale of Learning Strategies (EBEA).

Regarding objective two (evaluate the construct validity of a learning strategies scale), the exploratory factor analysis yielded a factor structure of two factors: elaboration strategies (composed of 7 items) and organization strategies (composed of 4 items).). Each of the items obtained a factor loading greater than .40, which is the requirement to be considered part of the factor, as indicated by Hair *et al.* (2014) (see table 3).

A first CFA confirmed the factor structure in most of the adjustment indicators (see table 4 and figure 2). However, to ensure construct validity, a new confirmatory factor analysis was performed. Then, 100% of adequate adjustment indicators were obtained by eliminating items EE2 (When I am studying and have doubts, I ask someone to explain to me) and EE5 (When I study I underline the most important things) (see table 5 and figure 3). , which served to respond to objective two.

Reliability analyzes done to achieve objective three—that is, examining the reliability of a learning strategies scale—were done for each factor structure obtained in the CFA. As indicated in tables 5 and 7, the three reliability criteria obtained (Cronbach's alpha , McDonald's omega and inter-item correlation) were adequate.

The above results in the brief scale of learning strategies (EBEA), composed of two dimensions or factors:

- Preparation strategies: Strategies that allow the understanding of the material through its codification, translation and relationship with previous learning.
- Organization strategies: Strategies that help the understanding of the contents through the design of graphic representations or summary that allow the information to be prioritized or classified so that said organization facilitates its understanding and subsequent recovery.

The dimensions found theoretically agree with what was presented by Pozo *et al.* (1990, 1994), who were the theoretical framework of reference for the design of the instrument.

With the achievement of the proposed objectives, it can be said that the brief scale of learning strategies (EBEA) shows sufficiency in measuring the intended variables and its reliability ensures precise measurements in its future applications. In short, the goal of providing a valid and reliable instrument to psychometrics has been met.

Now, regarding the objective " to examine the relationship between the learning strategies scale and the inventory of self-regulation learning processes", we can affirm the close correlation between the dimensions of EBEA and the inventory, of which all were significant and positive (see table 9). This serves as support to justify the present study, which emphasizes the importance of training students in learning strategies to develop the self-regulation process in them, since if the

study plans are not modified and training is inserted in learning strategies and self-regulation is modeled, it will be difficult to increase terminal efficiency in current competency models (García-Ripa *et al.* , 2016).

In this regard, it should be noted that, due to the pace of technological and scientific change today, it is not possible to predict what knowledge current students will need to know to face the challenges of their profession in the future, since knowledge is of limited duration. , unfathomable and in constant transformation (Pozo and Monereo, 2009). One way to successfully face the aforementioned changes is to have the capacity for autonomous learning and be a generator of knowledge, which is achieved through the planning, execution and evaluation of various activities that lead to learning.

Finally, it is necessary to mention that, like any study in school environments, this research may present problems in the honesty of the students when responding, since it is likely that they answer in terms of social desirability. Another limitation could focus on the strategies measured by EBEA, since most are common learning strategies in health sciences and humanities degrees; Furthermore, they are limited to the processes of elaboration and organization of learning, and do not include repetition strategies.

However, despite its limitations, the main strength of this study cannot be ignored: the creation of a valid and reliable instrument that quickly examines the use of strategies that lead to learning in university students.

Conclusions

Competency models aim to train students with the ability to learn in a continuous, autonomous and self-regulated way, so the assessment of the use of learning strategies takes on greater importance than the teaching of certain contents. Therefore, as mentioned, the main contribution of the present study was to provide psychometrics with a valid and reliable, but brief instrument of learning strategies. In this sense, it is necessary to mention that this contribution is not minimal, since for many novice researchers it is very difficult to start a research project , since they do not have a measurement instrument. In addition, it is very common to find high-impact instruments and journals related to clinical psychology or organizational psychology, which is more complicated in educational psychology.

On the other hand, as can be seen in the items, the strategies presented are specific, that is, they are some already defined by other authors and categorized to produce certain effects on

learning, and all include an action to be carried out by the student. unlike other instruments that include thought processes that are difficult to identify.

In this case, the university and the students' learning are the direct beneficiaries of this study, since - as Hernández Rojas (2006) mentioned - the school, in addition to teaching the knowledge of each discipline (conceptual, procedural, and attitudinal), should promote the development of cognitive and self-regulatory strategies that provide students with valuable instruments to become more effective and reflective learners.

In this context, so that the measurement of learning strategies in the classroom can truly occur, the role of the teacher is of utmost importance, since to form strategic students it is necessary to have strategic teachers who master the teaching and learning strategies. learning, so that they are able to train students in the best way (Méndez, 2015). In this sense, the teacher must know for what knowledge or procedures to use one or another strategy. Likewise, it must guide the student in their development, first acting as a model, then in a accompanied manner and then allowing autonomous development. If the teacher carries out these activities, he will be contributing to the self-regulation of learning strategies, which will later lead the student to self-regulation of their learning (Pozo, 2008).

Future lines of research

It is recommended that this study be replicated in different contexts and educational levels, including both the measurement of the variable *learning* and *self-regulation strategies* in order to sensitize educational authorities of the need to insert self-regulation processes into their educational programs. its students to learn how to learn, that is, to have the competence to generate their own learning, apply it to different contexts and continue with this process throughout their lives.

Likewise, it is necessary to indicate that when replicating it, its validity and reliability must be examined in the population that will be used. If you want to use it in a country whose language is different from Spanish , it is necessary to make an adaptation, using at least one specific technique for this, such as the backtraslation method .

On the other hand, regarding specific studies that could derive from this article, the following can be mentioned:

- Adaptation of the EBEA to different contexts.
- Analysis of learning strategies in competency-based and traditional educational models, with EBEA.

- Comparison of different samples regarding the use of strategies based on educational level, gender, major, subject or teacher who teaches the course.
- Correlation between the use of strategies, through EBEA, with age, educational level, semester and academic performance.
- Measurement of the frequency of use of learning strategies in typical cases, which involves selecting two samples: one of students with high averages and another with students with low averages. Additionally, analyze, among other variables, the frequency of use of learning strategies.
- Analysis of the relationship of learning strategies with motivation, self-regulation and information competence, constructs that favor the development of skills and self-learning.
- Analysis of the use of EBEA learning strategies with the use of situated teaching strategies proposed by Díaz Barriga and Hernández Rojas (2010): problem-based analysis and the case method. When research is carried out in school contexts, it is likely that students respond in terms of social desirability and could report using different learning strategies in self-report instruments, without this actually happening. Therefore, it is recommended to apply other quantitative instruments or qualitative techniques together with EBEA to triangulate the information collected.
- Application of an intervention designed to train students in the use of learning strategies. Based on the previous study, an experimental investigation is suggested with before and after measurements, and with a control group.
- Use of EBEA by university professors. University teachers are urged to use the EBEA at the beginning of their courses as a diagnostic evaluation and decide whether or not to train students in learning strategies before starting the course.

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