

Relationships between university students' temporal perceptions of affective and cognitive attributes of academic performance

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Abstract

Introduction: the variations of the intentional monitoring carried out by university students on attributes and temporalities of complex learning are analyzed. **Objective:** to identify the structural relationships between affective and cognitive attributes considered at different times of performance in two tasks of academic skills. **Method:** intentional sample of 420 students of Higher Education of Mexico and Colombia, of both sexes, answered: a) an inventory of the self-report on variations in attributes and temporal moments in two different tasks and b) two tests, one of comprehension of texts and another of mathematical skills. The theoretical models underlying the assumed academic performance were validated, empirically, through path analysis. **Results:** high rates of practical fit in all models, which allows identifying differential influences depending on the temporal condition in which the attributes operate, retrospective in the affective and concurrent in the cognitive. **Discussion:** the findings configure theoretical advances on the impact of temporality on the dispositions that students must show to act intentionally (that is, to be endowed with agency), in order to generate the transformations that their goals demand. These can serve as efficient markers for diagnostic artifacts, as well as for didactic procedures in the service of expert development.

Keywords: cognitive process; affectivity; time factor; performance appreciation.

Relaciones entre percepciones temporales de estudiantes universitarios sobre atributos afectivos y cognitivos del desempeño académico

Resumen

Introducción: se analizan variaciones del monitoreo intencional que realizan estudiantes universitarios sobre atributos y temporalidades del aprendizaje complejo. **Objetivo:** identificar relaciones estructurales entre atributos afectivos y cognitivos considerados en diferentes momentos del desempeño en dos tareas de habilidades académicas. **Método:** muestra intencional de 420 estudiantes de Educación Superior de México y Colombia, de ambos sexos, respondieron: a) un inventario del auto reporte sobre variaciones en atributos y momentos en dos tareas diferentes y b) dos pruebas, una de comprensión de textos y otra de

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habilidades matemáticas. Los modelos teóricos subyacentes al desempeño académico asumidos, fueron validados, empíricamente, mediante análisis de senderos. **Resultados:** altos índices de ajuste práctico en todos los modelos, lo que permite identificar influencias diferenciales dependientes de la condición temporal en la que operan los atributos, retrospectiva en lo afectivo y concurrente en lo cognitivo. **Discusión:** los hallazgos configuran avances teóricos sobre el impacto de la temporalidad sobre las disposiciones que el estudiante debe mostrar para actuar intencionalmente (es decir, para estar dotado de agencia), a fin de generar las transformaciones demandadas por sus metas. Estos pueden servir como marcadores eficientes para artefactos diagnósticos, tanto como para procedimientos didácticos al servicio del desarrollo de pericia.

Palabras clave: proceso cognitivo; afectividad; factor tiempo; apreciación de la actuación.

Introduction

The challenges derived from the need to transform educational structures and organizations to respond to the demands of a changing world highlight for educators the need to study the individual, collective, intellectual, personality, and social conditions that promote learning results required by the Knowledge Societies. In this context, the educational offer is increasingly qualified, and training practices whose results have traditionally been the generation of inert knowledge, inefficiencies in the solution of problems, and failures in the transfer of knowledge and skills are abandoned.

The analysis of the conditions that promote the development of knowledge has relied on the theoretical, methodological, and technical lead of contemporary Cognitive Psychology, particularly, on the research advances on a) academic learning (Winnie & Nesbit, 2010); b) students' personal epistemology (Pintrich, 2002); c) self regulatory knowledge and skills (Zimmerman, 1998); d) intentionality and volition, as well as the students' attributes responsible for the action control of study and learn behaviors (Kuhl, 2000a); and e) those of the indispensable emotional regulation

(Gross & Thompson, 2007; Pekrun & Linnenbrink, 2014). These have advanced the understanding of the attributes involved in the success of complex learning in academic situations.

However, the reality of the educational offer continues to show, in the Mexican context, an alarming proportion of higher education students with cognitive, metacognitive, and self regulatory heuristics that are deficient and associated with naïve epistemological belief systems, as well as diminished volitional, emotional, and motivational capacities (Castañeda, 2009; Castañeda & López, 1989; Castañeda & Peñalosa, 2016, 2018). Unfortunately, and at best, students evidence to have developed inert knowledge, for “the here and now.” The ephemeral nature of the results of this type of learning is a clear example of the results of the traditional paradigm in tertiary education in our environment.

In addition, the consideration of these aspects (cognitive, metacognitive, self regulatory, and affective) not only influences the learning process and its outcomes, but also represents viable resources that the student can use to respond to various demands of adjustment to tasks in academic and social contexts in order to safeguard their psychological well being. This is characteristic of situational process oriented approaches, i.e., state approaches that aim to understand a functional design in individuals, where different psychological aspects may interact in a differentiated manner depending on the particular situation encountered (Cervone, 2005).

This becomes even more important if we consider the new contingencies derived from the confinement process, where students have not only presented learning difficulties, but have also manifested mental health problems such as depression, anxiety, psychosomatic effects, stress, sleep problems, just to mention a few (González et al., 2020; Prada et al., 2021; Rojas et al., 2021; Yusvisaret et al., 2021).

Thus, recognizing that the new training of professionals also demands consideration of affective attributes—in addition to cognitive ones—requires a new pedagogy capable of encouraging the students themselves to generate experiences capable of influencing them in the

transformation of their environment and their own person (academic agency) in order to achieve the efficient fulfillment of goals in the various fields of academic, professional, and personal knowledge. Based on this, it becomes vital to generate evidence on attributes and conditions that influence the ways in which learning takes place, as well as on the psychological well being that favors this learning and the specific contexts in which it occurs ([Castañeda, 2012](#)).

This conception leads to take into account a dynamism in which different attributes are integrated and interact, capable of contributing, differentially, to the understanding of the phenomena of complex tertiary academic learning and the ways in which this has implications in the affective and cognitive states of the learners (and their strategies) in order to face the demands of fostering complex learning in educational tasks.

Thus, a new pedagogical paradigm in professional training requires structures organized around a learning approach based on performances of high formative value. In this way the student is perceived as an integral being with instrumental capacities that converge, integrating knowledge, skills, and affective regulations in reflection, reasoning, and problem-solving competencies, from which the student seeks to understand and act in the face of a phenomenon or task. This requires students to develop cognitive and non cognitive resources to be turned into high level ones, in such a way that they increase their agentive capacity, required by the different and complex academic, professional, and social tasks.

In this sense, academic agency refers to the student's willingness to selectively use heuristics thanks to which they can adjust their resources (cognitive and non cognitive) to the diverse demands posed by complex learning, in order to work successfully in diverse tasks and contexts. In other words, these are students capable of enriching their academic learning through the use, adaptation, and improvement of their own available resources.

Achieving this requires answering essential questions for the context of higher education, among others: Are the structures and organizations of Higher Education Institutions (HEIs) the

contexts where agency dispositions and autonomy are fostered in students? Are academic and personal achievements managed thanks to the coordinated, timely, and complex use of the student's own self system resources (cognitive and non cognitive), in interaction with the mediating resources provided by the HEIs (web artifacts or mobile technology, for example) and, of course, the professors themselves to cope with the diversity of demands coming from sources such as the context, the contents, and the task itself? If so, is it a priority to identify which are the available dispositions and to specify which ones show to have generated the required agentive load and which ones do not?

Explaining the complexity of the above demands developing (and submitting to empirical testing) theoretical models of complex learning in terms of their strategic aspects, as well as in terms of the metacognitive and self regulated aspects shown by a student when monitoring the task (and adjusting their level of proficiency to perform it). This will allow to identify the task from a perspective that is complex, multidimensional, related to the multiple contexts where the action is exercised, based on attributes that are highly sensitive to the complexity and nature of the phenomena under study. However, such a context demands considering the influences and interactions that generate cognitive and affective attributes in the way tasks are confronted.

One of these constructs, characterized by its multidimensional and integrative nature for complex academic learning, is that of academic agency. Its instrumentation includes cognitive attributes (learning strategies, metacognition, epistemological beliefs), as well as non cognitive ones (emotional and volitional) in order to research and encourage how and when these resources interact with the learner's agentive dispositions to activate and/or adapt them to the demands of self monitoring or intentional control that the learner must perform in order to be successful.

This macroconstruct incorporates multiple attributes to broaden and strengthen the understanding of what happens in the processes of formal knowledge construction ([Castañeda, 2012](#); [Castañeda, et al., 2014](#); [Castañeda & Peñalosa, 2016, 2018](#)). Thus, academic agency is seen as an

integrative and multidimensional construct of intentional action dispositions that the agent must possess to be endowed with agency in order to generate the required transformations related to their goals (Bandura, 2001; Castañeda, 2012). In this context, it is assumed that agency is characterized by a) the subject or agent who shows a high level of awareness, both of themselves and of their actions and b) who integrates competencies and attributes capable of influencing their availability to act and to achieve goals (Broncano, 2014).

In this frame of reference, cognitive, metacognitive, self regulatory, epistemological beliefs, affective, and volitional components have been included, which are considered to generate differentiated effects on the agentive capacity of students during a given learning episode, allowing to glimpse effects that are both facilitating and hindering in the performance of academic tasks (Castañeda, 2012; Castañeda et al., 2014; Castañeda & Peñalosa, 2018).

Based on this, it is possible to understand how affective aspects can influence the way cognitive attributes are implemented or how the quality of cognitive resources can have relevant effects on the learner's affective representation and, therefore, on the way they perceive and approach tasks in learning scenarios.

In this sense, cognitive and metacognitive variables are those orientation, planning and execution, monitoring, evaluation, and adjustment skills, used to develop different problem solving behaviors, as well as implications for students' knowledge of the information processing system and its functioning (Boekaerts, 1995).

Thus, the cognitive aspects refer to an active and constructive process through which the learner guides their behavior according to their goals and the contextual characteristics of the environment, which they consider necessary for the acquisition of new competencies with materials of increasing complexity (Pintrich, 2000; Rheinberg et al., 2000).

For their part, affective aspects consider mechanisms of a sub cognitive nature related to dimensions of energy and motivation, which have an impact on the perception that subjects

make of situations and, in turn, on the scope of thinking and action repertoires, their flexibility, as well as the implementation of willpower and self development (Fredrickson, 2013; Isen, 2008; Kuhl, 2000b, 2005).

In this sense, the affective appraisals that people make about different past situations (from positive to negative appraisals) guide the possible perceptions of an event and, thus, the possibilities that the subject finds to cope with them from their personal (cognitive and metacognitive) and contextual resources (Kuhl, 2000b; Kuhl & Kraska, 1989).

Based on this, the affective reactions that arise in the individual, in the face of a situation relevant to their goals will not only make them feel something, but will also generate in the subject the desire to do something or stop doing something. This is combined with reflections on the reasons to which their affective reactions and the results obtained are attributed (Frijda, 1986; Gross & Thompson, 2007; Weiner, 1986).

However, it should be noted that the identification of components with possible agentive load is insufficient. In view of that, it is also necessary to evaluate their structural relationships within different scenarios in order to consider their possible role and how they influence learning tasks of different nature and difficulty. Currently, the interest in this construct of agency has not only been to link it with various attributes with possible agentive load on learning. It has also been considered to investigate the possible interference of its temporality of occurrence since it is regarded as intentional actions that are oriented to the achievement of results in the near future (Beck et al., 2017; Chambon, et al., 2014). Given the above, it is then appropriate to consider whether other factors are involved in the subject's agentive capacity, under different levels of temporal appreciation, which may influence the cognitive and affective state with which the student faces a particular situation.

The above allows considering which agentive components of diverse nature may have different intervention actions, depending on the temporal perspective from which they are viewed, and the

levels of temporal proximity in which the results sought by the agent are oriented (Beck et al., 2017).

These perspectives have allowed for interactive developments on how affective, cognitive, and behavioral aspects are integrated, resulting in subjects being able to establish and organize their behaviors within temporal spaces, depending on the interaction between the demands of the task and those of their own abilities to solve them, that is, they generate a speculation of how long they will have to be executing something in a certain way (Varela, 2000; Videla & Torrejón, 2019). In this context, experience plays a fundamental role in what is done and how it is done since it resonates in the different structures, which can be given with different impacts (positive and negative), depending on the valuation of that experience, or, on what part of the experience the affect allows more access to in a given time (Clare et al., 2018; Videla et al., 2018).

Therefore, it is noted that affect, cognition, and their temporal impact intercede on the development of intuitive and motivational processes, and even in the level of valuation and awareness of the aspects considered relevant in the subjects' experiences.

Therefore, trying to clarify how these cognitive elements may be developing and connecting in a differentiated manner depending on the temporal space in which they take place, may be a means to deepen the understanding the subjects' experiences and their implications, both cognitive and affective, within the development of learning tasks. Besides being one more piece in the bridge about the way in which each agentive attribute can manifest itself and influence differently the agentive dispositions of the subjects, either as a facilitating resource or as a hindering element before, during, and after the execution of operations aimed at achieving intentional goals, these affective and cognitive temporal appreciations can influence the specific state of the subject, at the moment of performing an activity.

Based on these considerations, the present study sought to identify, in a sample of higher education students from Mexico and Colombia, the possible differential effects of cognitive, metacognitive, and affective components at three different moments

(prospective, concurrent, and retrospective) in relation to the performance of two broad spectrum academic tasks: text comprehension and mathematical problem solving.

Given the aforementioned interest, the objective of the research was to identify the relationships and differential effects of affective, cognitive, and metacognitive variables on performance in text comprehension and mathematical problem solving tasks at different moments.

To achieve the above, four models were validated using the statistical technique of path analysis. The theoretical models tested were configured as follows: a) a model of affective variables in text comprehension, b) a model of affective variables in mathematical problem solving, c) a model of cognitive and metacognitive variables in text comprehension, and d) a model of cognitive and metacognitive variables in mathematical problem solving.

Method

Research Design

The research has a quantitative, multivariate, cross sectional design with passive observation (Gómez, 2006; Hernández & Mendoza, 2018; Ñaupás et al., 2018).

Participants

A purposive, non probabilistic sample of 420 students from different institutions of higher education in Colombia and Mexico was considered.

Scenario

The application of the instruments was carried out during August and September 2018, through a web based tool called *Metaevaluador Web* (Castañeda & Peñalosa, 2016), which was used in the facilities of the computer centers of the participating institutions.

Instruments

A sociodemographic survey, a self report scale, and two performance tests were used to measure the study variables.

Academic Agency Inventory

To measure the cognitive, metacognitive, and affective variables of academic agency, the Academic Agency Inventory (Castañeda et al., 2021) was used, whose items and constructs were previously calibrated, validated, and made reliable with the population mentioned in this study.

The purpose of this inventory is to identify and quantify students' self evaluations of cognitive, metacognitive, and affective aspects which are present in three moments related to the execution of a task: prospective (before the execution of the task), concurrent (during the execution of the task), and retrospective (after the execution of the task or of a previous task considered similar). This inventory uses a Likert scale with four response options (strongly disagree, disagree, agree, and strongly agree).

The inventory is composed of 28 items, which are structured as follows (Table 1).

The construct validation indices for each dimension have the following fit values: Prospective. CFI=0.939; RMSEA=0.079; Concurrent.

CFI= 0.983; RMSEA = 0.034 and; Retrospective. CFI= 0.968; RMSEA = 0.072.

In turn, the reliability index, under Cronbach's Alpha, has a value of 0.912, which allows us to consider that the test has an excellent reliability (George & Mallory, 2003).

A Test of Performance in Mathematical Problem Solving

The test of performance in mathematical problem-solving (Peña et al., 2022) focuses on the evaluation of problem solving skills in the domains of arithmetic and algebra.

The test presents items in two contexts of evaluation retrieval, namely, recognition and memory. It should be noted that of the 30 items included in the test, 20 items with the best psychometric indexes of calibration and validation were used for this research, which were calibrated, validated, and made reliable with the population of this study. The items are distributed as shown in Table 2.

Tabla 1
Estructura Inventario de Agencia Académica

Dimensión	Reactivos	Subdimensión	Reactivos
Prospectivo	8	Afectivo	4
		Cognitivo-Metacognitivo	4
Concurrente	12	Afectivo	4
		Cognitivo-Metacognitivo	4
		Estratégico-Metacognitivo	4
Retrospectivo	8	Afectivo	4
		Cognitivo-Metacognitivo	4

Table 2
Structure of the Mathematical Problem-Solving Performance Test (adaptation of 20 items)

Dimension	Items	Context	Items
Arithmetic	10	Recognition	5
		Memory	5
Algebra	10	Recognition	5
		Memory	5

The validation indices of the test were as follows: CFI = 0.921; RMSEA = 0.044. The reliability index under Cronbach's Alpha was 0.857, indicating that the test has good reliability (George & Mallory, 2003).

Text Comprehension Performance Test

The text comprehension performance test (Castañeda, 1996) evaluates 10 text comprehension skills in two retrieval contexts (recognition and memory), based on a narrative text entitled "The Two Kings and the Two Labyrinths" (Borges, 1946).

The test structure includes 20 items that evaluate 10 types of comprehension responses in two contexts of evaluation retrieval: recognition and memory. The items used were previously calibrated, validated, and made reliable with the population of this study. The structure of the test is outlined in Table 3.

The validation indices of the test are as follows: CFI = 0.916; RMSEA = 0.046. The reliability index under Cronbach's Alpha is 0.854, which allows us to consider that the test has good reliability (George & Mallory, 2003). As can be seen from the psychometric data, all instruments met the standard criteria for construct validation.

Procedure

The procedure was implemented in three phases: (1) application of the self report inventory and performance tests; (2) formation of groups: low, medium low, medium high, and high; and (3) validation of four models on metacognitive and affective components of academic agency in mathematical problem solving and text comprehension tasks: (a) model of affective variables in text comprehension, (b) model of affective variables in mathematical problem solving, (c) model of cognitive and metacognitive variables in text comprehension, and (d) model of cognitive and metacognitive variables in mathematical problem solving.

It should be noted that the data was collected with the informed consent of the participants, and that the confidentiality of the data was kept, which was stipulated on Metaevaluator Web, which was the application tool. Likewise, participants were invited to the study through their respective professors and accepted to participate.

Table 3
Structure of the Text Comprehension Performance Test

Context	Items	Task	Items
Recognition	10	Main idea	1
		Detail	1
		Sequence	1
		Vocabulary	1
		Contrast	1
		Deduction	1
		Induction	1
		Summary	1
		Cause-effect	1
		Enumeration	1
Memory	10	Main idea	1
		Detail	1
		Sequence	1
		Vocabulary	1
		Contrast	1
		Deduction	1
		Induction	1
		Summary	1
		Cause-effect	1
		Enumeration	1

Data Analysis

The analyses of the data conducted were, on the one hand, nomothetic distribution analysis for the conformation of the groups, by establishing the upper and lower limits obtained from the mean and standard deviation and, on the other hand, validation of the four models by means of path analysis.

Results

First of all, it is convenient to mention some relevant sociodemographic characteristics within the population analyzed, noting the following elements: 76.2% are Mexican students and 23.8% are Colombian; 72.4% are female students and 27.6% are male; the students' ages range from 17 to 58 years, where the majority of the student population fall between 17 and 22 years—with an accumulated percentage of 81.2%; 31.2% work and study while 68.8% only study; 93.6% are single and the remaining 6.4% have some other marital status (divorced, separated, married, or in a partnership); as for the academic program they belong to, 44% are in the humanities and arts, 35.5% in the biological and health sciences, 17.1% in the social sciences, and 3.4% in physics-mathematics and engineering; 72.4% go to a public institution and 27.6% to a private institution; finally, the average grade is mainly concentrated between the scores of 61 to 70 (41.2% of the population) and 71 to 80 (41.4% of the population), considering a scale of 0 to 100.

Regarding the validation of the models to identify the relationships and effects that the different affective, cognitive, and metacognitive variables have on the performance of the two tasks, three goodness of fit coefficients were considered: X^2 and X^2/df coefficient, the comparative fit index (CFI), the incremental fit index (IFI), the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), the Tucker-Lewis index (TLI), the normalized fit index (NFI) and the root mean square error of approximation index (RMSEA) (Byrne, 2006; Pérez et al., 2013).

Based on this, the validation of the four models was carried out, where the metacognitive and affective variables were proposed as independent and intervening variables, while the variables on

performance in mathematical problem-solving and text comprehension were established as dependent variables: (a) model of affective variables in text comprehension, (b) model of affective variables in mathematical problem-solving, (c) model of cognitive and metacognitive variables in text comprehension, and (d) model of cognitive and metacognitive variables in mathematical problem-solving.

The validation results indicate that each of the theoretical models do not differ significantly from the empirical covariance structure matrix according to their practical fit indices, so all four models can be considered adequate.

Models of Affective Attributes in Text Comprehension and Mathematical Problem Solving

The models consider the variable on the retrospective valuation of affect as an independent variable and the prospective and concurrent variables of affect as intervening variables in the performance in text comprehension and mathematical problem solving tasks, respectively (Figure 1 and 2).

In both models, the X^2 data obtained values above zero, so they did not present statistical fit, since the X^2 is very sensitive to sample size in addition to assuming that the model fits the population perfectly. In view of that, other practical fit coefficients were taken into account to evaluate the representativeness of the model and to determine whether the relationships between the variables in the estimated model are a plausible way of reflecting the relationships observed in the data (Byrne, 2006; Weston & Gore, 2006).

Under these considerations, the X^2/df coefficient obtained values of 1.361 for the text comprehension model and 1.149 for the solution of mathematical problems; the comparative fit index (CFI), the incremental fit index (IFI), and the goodness-of-fit index (GFI) obtained values of 0.997; and the adjusted goodness of fit index (AGFI) was 0.984 for text comprehension. For mathematical problem-solving the comparative fit index (CFI) and the incremental fit index (IFI) was 0.999, the Tucker-Lewis index (TLI) was 0.993, and the normalized fit index (NFI) was 0.989.

Figure 1

Validated Model and Goodness of fit Indices of the Model of Affective Variables in Text Comprehension

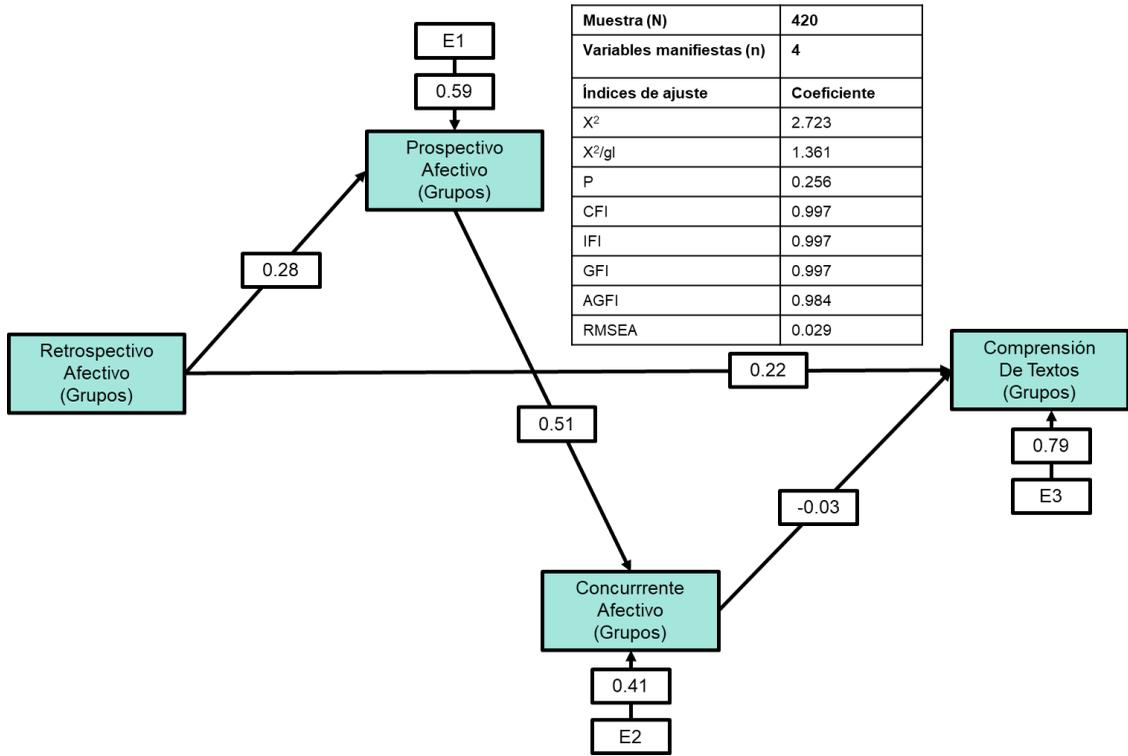
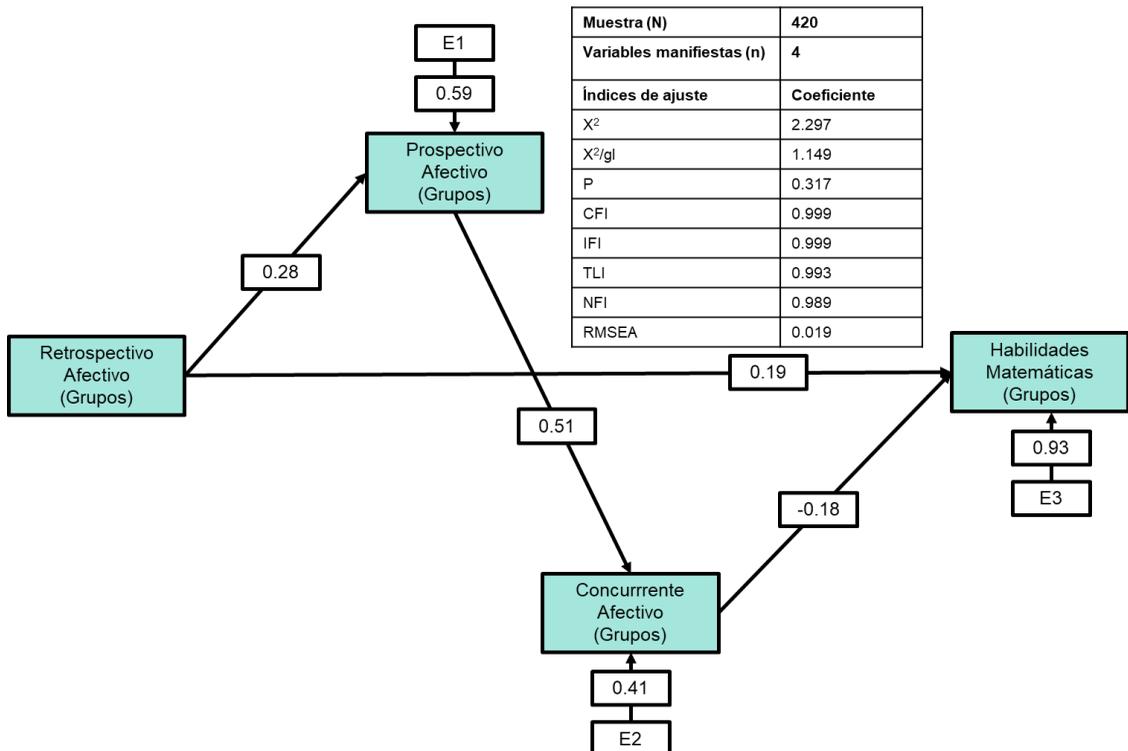


Figure 2

Validated Model and Goodness of fit Indices of the Model of Affective Variables in Mathematical Problem Solving



Likewise, the value of the root mean square error of approximation index (RMSEA) had a value of 0.029 for the text comprehension model and 0.019 for the mathematical problem-solving model. Thus, it is possible to consider that both models are representative in reflecting the observed relationships between the variables.

Based on these results, it was possible to propose that, both in text comprehension and mathematical problem-solving tasks, retrospective perspectives of affect tend to have higher effects than prospective and concurrent ones, that is, that affective states derived from post task performance present a higher congruence in determining the possible outcome of the task, whereas affective states prior to and during task performance can be shown to be influential on this type of academic tasks.

Thus, it can be suggested that students may have affective states that undervalue or overvalue their performance, either before or during the task, which can configure a particular state where the student is positively or negatively oriented towards the task. That is, they may generate affective states of joy, enthusiasm, and positive mood when involved in novel, complex, and long lasting tasks through which they will be able to develop knowledge and skills; or they may generate affective states of displeasure, boredom, uneasiness, and/or anger, when involved in this type of tasks.

However, the affective perception that seems to be more stable and less biased is the post-task one, which can better predict the performance shown in the task since the experience is relatively fresh and the state of peak stress may have passed. This may lead the subject to evaluate their performance in terms of areas, such as the feeling of accomplishment, achievement, as well as states of joy and happiness linked to a valuable perception of the result, or the opposite case.

Therefore, revisiting this emotional perception after the task becomes a very useful tool to identify the states of well being—or not—derived from a particular academic task. It is a good way to identify the student's perceptions by considering the temporal aspect as a good predictor of both their possible performance and their affective states to engage in this type of task.

The validated model was able to integrate the

participation of affective variables in relation to the valuation of academic tasks at different moments of their execution. In addition, it showed the influence of the retrospective aspect of affect on the performance of academic tasks of text comprehension and mathematical problem solving, which highlights this retrospective capacity of affect as a component of high significance in relation to learning skills from the perspective of academic agency, where the ability to take into account the affective experiences becomes a resource for the subject to seek ways to work with the derived emotion.

Models of Cognitive and Metacognitive Variables in Text Comprehension and Mathematical Problem Solving

These models contemplate the variable on the retrospective ability of cognitive and metacognitive aspects of the task as an independent variable; the variables on cognitive, strategic, and metacognitive aspects at the prospective and concurrent level as intervening variables; while the dependent variables refer to the performance shown in text comprehension and mathematical problem-solving tasks, respectively (Figure 3 and 4).

As in the previous ones, both obtained X^2 values greater than zero, which means that they do not present a statistical fit under this criterion since the data can only fit the real world in an approximate and never exact way (Byrne, 2006). The coefficient of the X^2/df obtained values of 4.016 for text comprehension and 2.542. The comparative fit index (CFI) and the incremental fit index (IFI) had values of 0.977 for text comprehension and 0.991 for mathematical problem-solving. The goodness-of-fit index (GFI) was 0.982 and the adjusted goodness-of-fit index (AGFI) was 0.945 for text comprehension, while the Tucker-Lewis index (TLI) was 0.963 and the normalized fit index (NFI) was 0.98 for mathematical problem-solving.

For the root mean square error of approximation index, values were low, being 0.085 for the text comprehension model and 0.061 for the mathematical problem-solving model. Based on this, it could be considered that both models are representative and reflect a plausible relationship between the variables proposed in them.

Figure 3

Validated Model and Goodness of fit indices of the Model of Cognitive and Metacognitive Variables in Text Comprehension

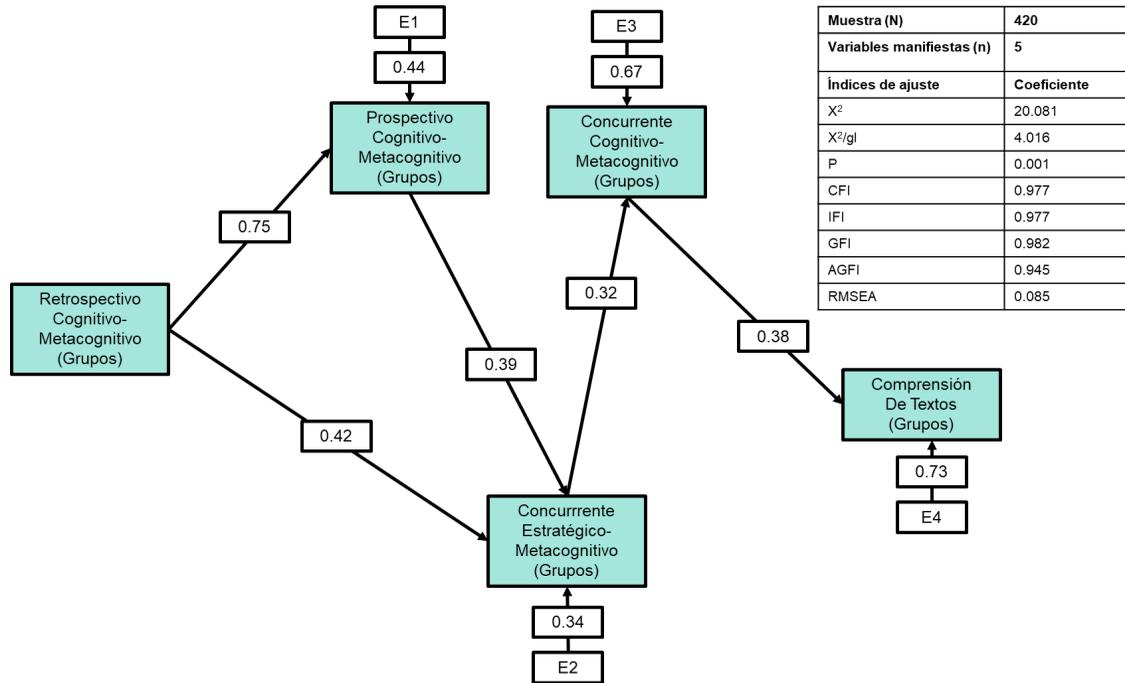
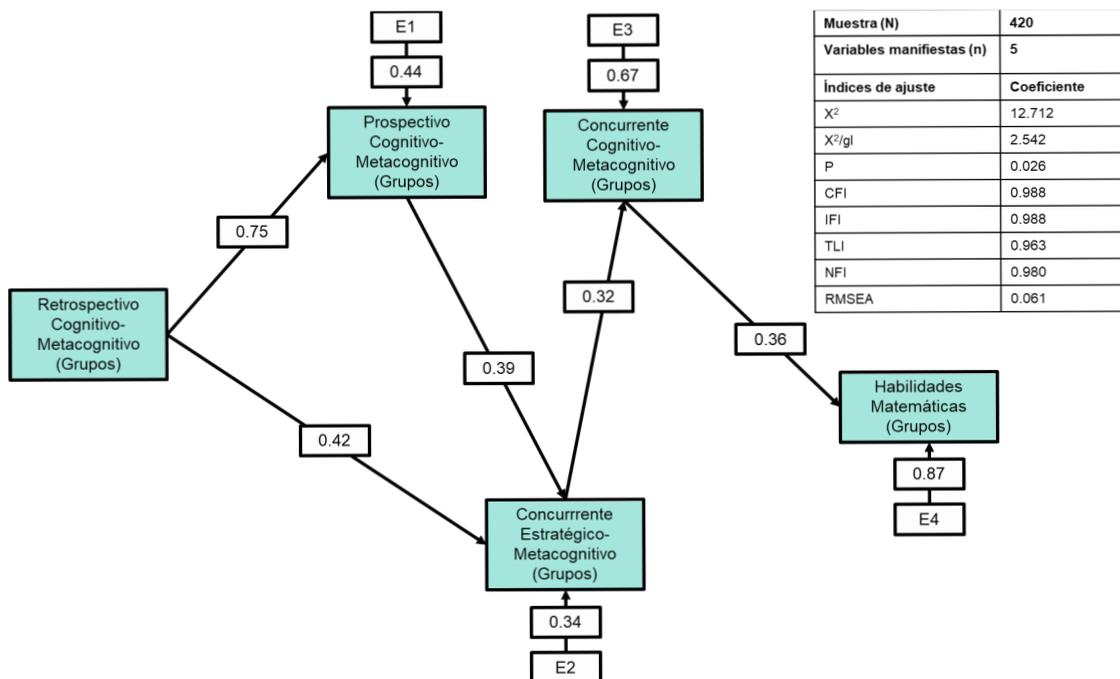


Figure 4

Validated Model and Goodness of fit Indices of the Model of Cognitive and Metacognitive Variables in Mathematical Problem Solving



Thus, it is shown that, in both types of tasks (text comprehension and mathematical problem-solving), the concurrent cognitive and metacognitive skills have a direct effect on their performance, that is, it is during the execution of the tasks that cognitive and metacognitive strategies are of utmost importance, since their implementation has a direct influence on the result obtained.

In this sense, in order to solve a problem, it is a priority for the student to identify the type of knowledge involved (declarative, procedural, and conditional), as well as the strategies that can be applied for its resolution. This denotes the importance of carrying out a heuristic process from which to establish immediate operative actions that consider the type of task that is demanded and, therefore, the most efficient ways to approach it.

On the other hand, the retrospective level remains a variable that has indirect implications on concurrent cognitive and metacognitive strategies by influencing the prospective and strategic portion. In this way, the approach based on elements that have arisen before or after executing the task influences the anticipatory or planning portion and the form that the possible strategies to be considered for executing a task will take. Achieving this implies that the student made an evaluation to identify rights and wrongs in the way of approaching the task, which are configuring a baggage of experiences that are revisited at the prospective moment.

In this sequence, the prospective aspect will give rise to possible strategies to be considered convenient during the execution of the task, such as taking precautions or foreseeing possible situations that may arise during the activity. These considerations are expressed in an action plan that will influence the cognitive and metacognitive skills established during the performance of the task.

Based on this, it can be suggested that, at the cognitive and metacognitive level, being present in the here and now has direct implications on the task, because it is at that moment when the demands of the task become present and require an immediate and constant solution. In this way,

previous experiences and planning, despite having relevance in the performance of the task, are subsumed to what the subject does at the moment of executing the actions to solve the task.

Thus, unlike the models that integrate affective variables, the concurrent aspects are the those that have a direct and more precise influence at the moment of evaluating performance in an academic task.

In this sense, a fundamental part would entail revisiting the affective experiences of the subjects, especially of prospective character, as scenarios that will orient their agentive dispositions, linking, at the moment of execution, self-monitoring of their actions that will allow the subject not only to solve a task, but also to reach an affective state of well being.

Discussion

The research sought to identify the relationships and effects of cognitive, metacognitive, and affective variables, addressed at different moments, in the performance of basic-skill tasks in higher education, such as text comprehension and mathematical problem solving.

The analyses allowed the validation of four models, in order to appreciate the differences in the cognitive, metacognitive, and affective variables in the two aforementioned tasks.

From this, it can be posited that the affective aspect finds its greatest influence within the retrospective aspect, which leads to consider that the affects presented subsequent to the performance of a task or based on previous similar experiences are usually an agentive dispositional mechanism that allows the student to predict or consider their performance within future academic tasks. Thus, in line with [Varela \(2000\)](#) and [Videla and Torrejón \(2019\)](#), the students' performance will not only depend on the present moment, but also involves speculations about what may happen and, therefore, how the subjects may feel in that situation. This, in turn, will influence the way the learner responds, that is, how they do and will do things to achieve or

avoid something, depending on the affective evaluation of their experiences (Clore et al., 2018; Videla et al., 2018).

This would allow to understand how having the affective appreciation of a state prior to the pandemic as a reference becomes a factor that may be linked to the presence of learning and psychological health problems. This is due to the fact that the current assessment could focus on the substantial loss of lifestyles that were satisfactory and a relevant part of the student's previous experiences, as may be the case of the change from face to face activities to distance activities. On the other hand, the cognitive and metacognitive aspects that have a direct effect on performance are those that are established in the concurrent sphere, that is to say, while the student is executing the task, although the concurrent aspects will be influenced by the prospective and retrospective domain. Therefore, previous experiences, planning, and implemented strategies may enrich the cognitive and metacognitive control of the subject during the performance of the task, but it is this specific moment that has the direct effects on performance, because the results depend on what the students do or fail to do at the moment they are executing the task.

These results allow us to be confident, from the perspectives of Beck et al. (2017), that the levels of temporal proximity of what the agent (the student showing intentional actions) seeks or is valuing will lead to the cognitive, metacognitive, and affective aspects having differential configurations and influences depending on the moment in which the students' actions are being executed. Thus, the subject's academic agentive capacity has differentiated contributions from the cognitive and affective attributes and depend on the moment of the task, which implies that the agent will seek a learning achievement that in turn is linked to affections of joy, enjoyment, and accomplishment.

In this way, the models presented have proposed a plausible structure of the relationships between the different variables analyzed to increase the understanding of what happens in academic learning spaces and how learning is linked to

positive and/or negative affective states derived from the evaluations and forms of resolution of educational experiences.

Based on this, it can be established that, when there is a retrospective capacity at the affective level, the subject can enrich their experience and judgment to forecast his performance or identify their possibilities to perform a task. Also, the capacity to be in the here and now at the cognitive and metacognitive level will have direct implications on performance, although this capacity will also depend on the capacity to link the strategic, prospective, and retrospective elements in their performance.

To account for the influence of these variables complements the characterization of academic agency: it identifies which aspects are involved in it and how and when they interact with each other, as well as when they must be available to facilitate its presence, either when teaching or in professional practice scenarios. In addition, it makes explicit that the agent develops actions to achieve results that are linked to affective states, in other words, the agent does something that will also make them feel something that they seek to feel (Frijda, 1986; Gross & Thompson, 2007).

Thus, the various developments presented in this work, on the one hand, configure useful diagnostic tools to know the underlying characteristics of the different components that differentially influence the performance of higher education students in various learning episodes, as well as the cognitive and affective implications that underlie the different behaviors of the learner and can generate functional or problematic behaviors in different instances.

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