



Evolution of learning patterns during the first years at university and their relationship with academic stress, effort, and performance

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Abstract

This study examines how learning beliefs and strategies—referred to as learning patterns—evolve among Ibero-American students during the first 2 years of university. It also explores the relationship between these patterns, academic stress, and performance. This study aims to shed light on these dynamics (beliefs and learning strategies) to address the persistently high rates of early university dropout in Ibero-America. The participants are 458 students enrolled in Educational Sciences programmes across eight different universities. The Inventory of Learning patterns of Students (ILS) was applied to identify learning patterns (Meaning Directed, Application Directed, Reproduction Directed, and Undirected or the combination between their components). The Academic Stress Questionnaire at University (CEAU) was used to measure stressors, R-CEA for reactions to stress, and A-CEA for coping strategies. Additionally, effort was identified with a Likert scale under the student's perception, and academic performance was calculated based on grade point average. The results highlighted the notable advantages enjoyed by students with high level of self-regulation and academic stress coping strategies. Conversely, students who scored high on external regulation or lack regulation, who lacked effective coping strategies and exhibited certificate-oriented motivation, faced greater challenges in adapting to university and tended to perform less well academically. The study suggested how university teachers can help students with a lack of regulation or external regulation strategies to improve their academic performance and better cope with academic challenges, especially in cases with high levels of academic stress and difficulties in socio-emotional management, among others.

Keywords Learning patterns · Academic stress · Effort · Academic performance · Higher education

Introduction

Learning patterns constitute a particular configuration of beliefs about learning that determine learning strategies and regulation. These patterns may be oriented towards meaningful learning, reproductive learning, or undirected learning, depending on certain personal and contextual factors (Vermunt, 2005). Therefore, it is possible to find students who begin university with learning patterns based on memorisation or other less adequate profiles (Vega-Martínez et al., 2023a), which often clash with the challenges of autonomy posed by higher education (Kyndt et al., 2017). In this regard, the challenge lies in fostering a constructive conception of learning grounded in intrinsic motivation that promotes self-regulation and deep processing strategies. This is especially important because the transition to higher education reveals that many students begin university with misconceptions about learning and rely on superficial processing strategies sustained by external regulation (Kyndt et al., 2017), which in turn contributes to academic stress (Vega-Martínez et al., 2023a).

Therefore, it is necessary to identify how their conceptions of learning, motivational orientations, regulation, and processing strategies interact to generate different learning approaches. The most inappropriate patterns, such as those related to reproduction or based on doubts and fear of university challenges, often explain academic failure (Vermunt & Donche, 2017). In this regard, the dropout rate in Ibero-America (Spain 35.2% and Latin America 50%) is notably higher than the European countries (EU) (28%) and the goals that the EU proposed for 2020 (a maximum of 10%) (OECD, 2025; World Bank, 2017).

The highest dropout rate occurs during the first 2 years of university (Ministry of Universities, 2020; World Bank, 2017). Indeed, the demands for critical and self-regulated thinking required at university create tension with superficial strategies such as memorisation (Kyndt et al., 2017; Martínez-Fernández et al., 2019, 2025; Vermunt & Donche, 2017), which results in high levels of academic stress (Vega-Martínez et al., 2023a; Taboada, 2015). When students realise that their previously successful learning strategies are no longer effective or relevant, stressors emerge leading to subsequent physiological changes (Suárez-Montes & Díaz-Subieta, 2015). Prior academic experiences may conflict with the demands of the university context, creating situations that challenge students' existing skills and knowledge. These circumstances require students to actively use coping strategies (Jurado-Botina et al., 2021; Taboada et al., 2019) and to make sustained efforts to adapt and overcome the difficulties they face (Vega-Martínez et al., 2023a). To this end, university students would be expected to transform their learning pattern by acquiring adequate beliefs and strategies such as the construction of knowledge, self-regulation, deep processing, and intrinsic motivation (Vermunt et al., 2023).

Research on learning patterns (Vermunt, 1998) reveals that meaning-oriented and/or application-directed patterns promote better adaptation to university, whereas reproductive or undirected patterns increase vulnerability to stress and poor academic performance.

Considering the above, the present study analyses the evolution of learning patterns among Ibero-American university students in Educational Sciences, exploring the relationship between these patterns and academic stress, with a focus on stressors, reactions, and coping strategies. Furthermore, these variables are considered in relation to students' effort and academic performance, allowing for an analysis of the learning patterns associated with both high and low achievement.

Learning patterns

The learning patterns model (Vermunt, 1998, 2005, 2020) explains how different components interact to define student learning approaches. Each component fulfils a specific function: conceptions reflect beliefs about what learning is; orientations represent the motives that drive study; regulation refers to how students plan, monitor, and adjust their learning; and processing describes how students engage with the content. Although these elements are distinct, in practice, they overlap and combine into different patterns, depending on the degree of alignment among them. The four patterns initially identified by Vermunt are as follows: Meaning Directed (MD), which consists of understanding learning as a construction, with personal interest, critical thinking, and self-regulation; Application Directed (AD), based on a conception of learning as the use of knowledge, vocational orientation, with concrete processing, external, and self-regulation; Reproduction Directed (RD), defined from a conception of learning based on intake of knowledge, oriented towards certificates, with external regulation and rote processing; and Undirected (UD), with conceives learning as a process stimulated by teachers and peers, marked by ambivalent orientation, lack of regulation, and scarce processing strategies.

Additionally, the previous research shows other pattern combinations: Passive-Idealistic (PI), which brings together learning conceptions without accompanying strategies (Martínez-Fernández & García-Ravidá, 2012; García-Ravidá, 2017; González & Difabio de Anglat, 2016); Passive-Motivational (PM), which ties various learning orientations whole together (García-Ravidá, 2017; Song & Vermunt, 2021); as well as combinations such as grouping the MD/AD into a single pattern, or the emergence of a MD/external pattern (Martínez-Fernández & Vermunt, 2015). In some cases, the patterns are considered dissonant or incongruent (Rabanaque & Martínez-Fernández, 2009) when beliefs (conceptions and learning orientations) do not fit with the strategies (regulation and/or processing). Such dissonance illustrates how components of the model may diverge (Vermunt & Vermetten, 2004), especially in transition context, e.g. from secondary education, higher or postgraduate education—where students' motives or beliefs do not correspond to the strategies they are able to employ and they may struggle to discern between what is relevant in the new learning context (Martínez-Fernández, 2019; Kyndt et al., 2017).

Vermunt (2020) argued that learning patterns are globally distributed, with RD and UD patterns remaining relatively stable (Shum et al., 2024), despite some inconsistencies across territories (Ciraso-Calí, 2023). For example, in Ibero-American context, evidence found that the PI pattern is identified and the AD pattern does not emerge (Martínez-Fernández & Vermunt, 2015; García-Ravidá, 2017; Martínez-Fernández et al., 2019, 2025).

Although regulation strategies play a central role in the model, they do not merely mark distinctions; rather, they determine which type of regulation is activated (Shum et al., 2024). Thus, in Northern Europe, students consistently activate self-regulation (MD pattern). In Ibero-America, external regulation drives self-regulation as part of the MD pattern, known as the Latin-American and Spanish paradox (Martínez-Fernández & Vermunt, 2015; García-Ravidá, 2017; Vega-Martínez et al., 2023a; González & Difabio de Anglat, 2016). In Asia, high scores in information block conception (RD pattern) coexist with self-regulation (Biemans & Van Mil, 2008).

Academic stress

Academic stress results from the dissonance between the academic environment, students, and teachers (Restrepo et al., 2020). Students may perceive situations as

threatening (Kristensen et al., 2023), and their ability to cope depends on their resources and mechanisms (de la Fuente et al., 2020) as well as the coping strategies they use, which influence their emotional well-being and health (Jurado-Botina et al., 2021).

Stress is higher in the first years of university and decreases in the later years (Cabanach et al., 2018; de la Fuente et al., 2020). Although stress factors are diverse, they are grouped into common categories (García-Ros et al., 2012). These factors activate emotional, physical, cognitive, and behavioural symptoms (Kristensen et al., 2023). Thus, it is crucial to activate coping strategies to mitigate their impact (Cabanach et al., 2018) (see Table 1).

Focusing on Ibero-America, studies have identified academic obligations as the main stressors (Holgado et al., 2019; Taboada, 2015), followed by expressing and communicating ideas (García et al., 2016; Restrepo et al., 2020). For instance, the main symptoms include physical exhaustion, sleep disturbances, irritability, and negative thoughts (Bedoya & Vásquez, 2019; Ramos et al., 2020). The primary coping strategy is social support, followed by planning and managing personal resources and positive revaluation (Cabanach et al., 2018; Montiel-Cortés et al., 2020; Rodríguez & Canedo, 2020).

Table 1 Stress factors, reactions to stress, and coping strategies

<i>Stress factors</i>	
Academic obligations (AO)	It includes situations arising from academic workload (accumulation or overload of assignments, tight deadline, and exams)
Performance and future perspectives (PFP)	Concerns about completing studies on time, maintaining academic performance, retaining scholarships, and deciding on subjects and career paths
Interpersonal difficulties (ID)	Experiencing situations of conflict, tension, or competitiveness with classmates or teachers, difficulties in social integration in the academic environment, etc.
Expression and communication of own ideas (EC)	It includes situations that require oral presentations or participating in class discussions
<i>Reactions to stress</i>	
Sleep disturbance (SD)	Problems falling or staying asleep, insufficient rest, or non-restorative sleep
Irrascibility (IR)	Increased sensitivity to frustration, irritability, and a tendency to become agitated in academically demanding situations
Physical exhaustion (PE)	Persistent feelings of tiredness, decreased energy, and muscle tension, associated with prolonged exposure to stress
Negative thoughts (NT)	Pessimistic, demotivating, or useless thoughts regarding academic tasks or personal performance
<i>Coping strategies</i>	
Positive revaluation (PR)	Strategies aimed at creating a positive meaning about the problem or academic difficulty
Search for social support (SSS)	Request for emotional support, academic guidance, or assistance from peers, family members, or teachers
Planning and management of personal resources (PMR)	Developing strategies for organising time, prioritising tasks, and making appropriate use of available resources

Academic performance and effort

Academic performance is defined as the assessment or grade obtained as an indicator of the level of achievement in terms of compliance, or not, with the learning objectives (Cardenas et al., 2020). Thus, the teaching strategy usually includes the design of evaluation activities to determine the degree of achievement of such learning objectives. In this regard, effort leads the individual to optimise their resources, which generally results in better academic performance (Alegre, 2014; Martínez-Fernández & Vermunt, 2015).

During secondary education, teachers provide direct and close guidance, whereas at university, autonomous learning prevails (Bardach, et al., 2023). However, several authors argue that effort alone does not guarantee academic success; rather, success arises from the interaction between effort and the learning strategies employed (Cardenas et al., 2020). Empirical evidence indicates that greater effort is associated with enhanced self-regulation strategies (Martínez-Fernández & Vermunt, 2015; Vega-Martínez et al., 2023b), with the activation of deep processing strategies (Gaeta-González et al., 2020), and consequently, with improved academic performance (Martínez-Fernández & García-Ravidá, 2012; Martínez-Fernández & Vermunt, 2015; Vega-Martínez et al., 2023b).

Learning patterns, academic stress, and performance

Few studies have examined the joint contribution of learning patterns, academic stress, and effort to university failure. Although prior research has linked these variables individually to academic performance (Alegre, 2014; Gaeta-González et al., 2020; Martínez-Fernández & Vermunt, 2015; Vermunt, 2005), longitudinal studies that integrate learning patterns and academic stress as concurrent explanatory factors for university dropout or failure are lacking. Addressing this gap is essential: a combined analysis can clarify whether certain learning patterns moderate or mediate the effect of academic stress and effort on academic outcomes and thus inform targeted interventions to reduce stress and retention problems. In that sense, studies show that the Meaning Directed (MD) and the Application Directed (AD) patterns are associated with a better academic performance. The Reproduction Directed (RD) pattern shows a certain significant relationship, of lesser effect, with academic performance in some of its subscales, although in general a significant negative relationship has been found between RD pattern and performance. Finally, the Undirected (UD) learning pattern is related to the poorest academic outcomes (Martínez-Fernández & Vermunt, 2015; Vermunt, 2005).

Regarding the relationship between academic stress and performance, empirical evidence suggests that both the presence of stressors and the resulting stress reactions are negatively associated with academic performance (García-Ros et al., 2012; Taboada, 2015). High levels of academic stress have shown to relate negatively to critical thinking and academic motivation (Trigueros et al., 2020). In reverse direction, coping strategies correlate positively with academic performance, whether they are active strategies (such as positive revaluation or planning and management of resources), or passive strategies (such as the search for social support) (Cabanach et al., 2010, 2018; Taboada, 2015; Taboada et al., 2019).

The few studies that examine the relationship between learning processes, stress, and performance indicate that superficial conceptions of learning, as well as the lack of regulation, are associated with academic stress and the absence of effective coping strategies. On the contrary, deep focus and self-regulation are related to less academic stress, greater

coping strategies, and better performance (Achahui & Zulema, 2019; Vega-Martínez et al., 2023a). Other authors suggest that students with a lack of regulation tend to display reduced emotional management and a greater number of academic stress-related symptoms (Vega-Martínez et al., 2023a; de la Fuente et al., 2020). These characteristics, coupled with low grades and the possibility of not successfully completing the first year, suggest a lower likelihood of staying at university. During this period of university integration, students may experience high levels of stress, uncertainty, and lack or low motivation (Álvarez-Pérez & López-Aguilar, 2019). These reports highlight the importance of addressing academic transitions and other contextual issues such as moving away from the family, building new relationships, and working while studying (Martínez-Fernández et al., 2019).

This study examines the interrelationships between learning patterns and academic stress, two constructs that have each been linked to academic performance but are rarely analysed together. Using a sample of Ibero-American students selected because of the region's elevated university dropout rates, this research integrates these variables to evaluate their combined influence on academic outcomes. By adopting a joint analytical approach, the study aims to clarify whether specific learning patterns amplify or mitigate the effects of academic stress and thereby inform targeted interventions to reduce dropout and improve student retention.

Considering the above, and the high rates of university dropout in Ibero-America, especially during the first 2 years of university, this study aimed to answer the following research questions:

1. What is the evolution of learning patterns during the first 2 years at university and their relationship with academic stress, effort, and performance among Ibero-American university students?
2. Which student profile describes high and low performance, as well as university dropout?

Based on the studies reviewed and their theoretical foundations, the following hypotheses are expected:

H1. During the first 2 years of university, the scores of students with MD and AD patterns increase, correlating positively with the use of coping strategies, academic effort, and high performance. Conversely, students who initially display a UD pattern tend to transition towards a RD pattern, which is associated with higher levels of stress, negative reactions, and low academic performance.

H2. The high-performance profile is described by the MD pattern, with high levels of coping. The low-performance profile is associated with the RD pattern, high stress, and negative affect. The dropout profile is described by the UD pattern, high stress, and negative affect (Fig. 1).

Method

Design

The study employed a quantitative approach with a longitudinal design, utilising a series of surveys administered at two different points in time. Firstly, the Inventory of Learning patterns of Students was applied to identify learning patterns, obtaining data on academic

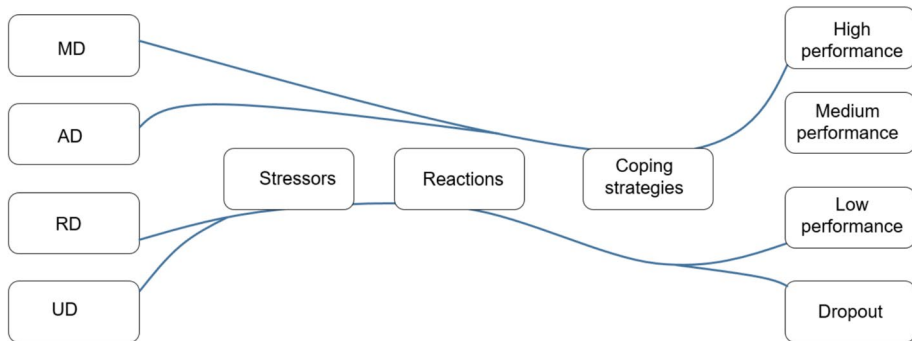


Fig. 1 Relationship between learning patterns, academic stress, and performance

performance and self-perceived effort at the beginning of the second semester of the first year of study (year 1), when the students already had some university experience. Six weeks later, outside the evaluation period, the academic stress questionnaires (stressors, reactions, and coping) were applied. This process was repeated in second year (year 2) with those students who had not dropped out, obtaining a smaller sample. A total of 458 students participated in the first measurement and 384 in the second (83.8%). The 74 non-respondents (16.2%) had withdrawn from university, reporting difficulties in keeping up with academic demands. No missing data were detected, as all questionnaires were fully completed at both measurement points.

Participants

The sample included 458 Ibero-American university students aged between 16 and 48 years ($M=20.4$; $SD=3.80$). An exploration of the data did not reveal significant differences in the scores of the study variables in relation to those of younger age, so the students over 30 were included in the analyses. The participants were 80% women. The distribution by origin was as follows: Argentina (13.8%), Chile (11.8%), Colombia (12.4%), Mexico (6.4%), Peru (20.5%), Spain (30%), and Venezuela (5.1%). All of them were students in Educational Sciences or related fields (Early Childhood Education, 16.2%; Primary Education, 10.7%; Social Education, 17.5%; Pedagogy, 43.4%; Psychology, 10.2%; Special Education, 2%).

Instruments

The Spanish adaptation to the Inventory of Learning patterns of Students (ILS) (Vermunt, 1998, 2020) was applied in its reduced version (Martínez-Fernández & García-Orríols, 2017). It is composed of 60 items grouped into 16 subscales. The questionnaire has two parts: one grouping beliefs about study (conceptions of learning and learning orientations), and the other grouping items about actions (regulation and processing strategies). Both parts are answered on a Likert scale with a range from 1 to 5. The belief subscales indicate agreement from least to most agreement with the statement, and the strategy subscales indicate the frequency of use.

The reliability values, according to Loewenthal (1996) and Nunnally and Bernstein (1995), indicated that eight subscales show acceptable levels of consistency ($\alpha \geq .70$).

Table 2 Alpha values, mean, and deviation of the learning patterns subscales

	Alpha	Mean	Standard deviation
<i>1. Learning conceptions</i>			
Construction of knowledge	.70	3.96	0.76
Intake of knowledge	.60	3.24	0.84
Use of knowledge	.74	3.88	0.76
Stimulating education	.69	3.69	0.83
Cooperative learning	.58	3.29	0.84
<i>2. Learning orientations</i>			
Certificate oriented	.54	3.56	0.91
Self-test oriented	.63	3.47	0.96
Vocation oriented	.74	3.93	0.87
Ambivalent	.65	2.60	0.98
<i>3. Processing strategies</i>			
Deep processing	.78	3.50	0.71
Reproductive processing	.77	3.03	0.78
Concrete processing	.70	3.71	0.83
<i>4. Regulation strategies</i>			
Self-regulation	.77	3.31	0.79
External regulation	.74	3.20	0.72
Lack of regulation	.63	2.99	0.87

Table 3 Alpha values, means, and deviations of stressor sub-scales

Stressors	Alpha	Mean	Standard deviation
Academic obligations (AO)	.82	3.23	0.77
Performance and future prospects (PFP)	.78	3.12	0.85
Interpersonal difficulties (ID)	.69	2.45	0.81
Expression and communication of own ideas (EC)	.70	2.84	0.97

whereas five show adequate values ($\alpha \geq .60$), if considering that the subscales have less than 10 items. Two subscales achieved adjusted coefficients ($\alpha \geq .50$): item 23 was removed from the Certificate Orientated Subscale to improve its reliability (from .51 to .54). The personal interest subscale was discarded due to its value falling below .50 ($\alpha = .49$) (see Table 2). It should be noted that the personal interest subscale generally shows an inadequate reliability index with samples of Ibero-American students (Martínez-Fernández, 2019).

The Academic Stress Questionnaire at University (CEAU; García-Ros et al., 2012) was applied to obtain information about the stressors. It has 21 items answered using a Likert scale 1 (no stress) to 5 (a lot of stress). The stressors are grouped into four subscales: academic obligations (OA; 7 items); performance and future prospects (PFP; 6 items); interpersonal difficulties (ID; 3 items); and expression and communication of own ideas (EC; 3 items). Cronbach's alpha reliability values indicated that the subscales or stressors demonstrated adequate levels of internal consistency (see Table 3).

Table 4 Cronbach's alpha, mean, and deviation for the reaction sub-scales

Subscales (reactions to stress)	Alpha	Mean	Standard deviation
Sleep disturbance (SD)	.90	2.64	0.98
Irascibility (IR)	.90	2.66	1.03
Physical exhaustion (PE)	.90	3.17	1.03
Negative thoughts (NT)	.83	2.54	1.01

Table 5 Cronbach's alpha indices, mean, and deviation of academic stress coping strategies

Subscales (coping strategies)	Alpha	Mean	Standard deviation
Positive revaluation (PR)	.89	3.09	0.79
Search for social support (SSS)	.90	3.05	0.92
Planning and resource management (PMR)	.82	3.03	0.76

The Reactions-Academic Stress Questionnaire (Reactions), (R-CEA; Cabanach et al., 2008) with 22 items answered in a Likert scale 1 (never) to 5 (always) was used to identify the set of symptoms associated with the different reactions: sleep disturbances (SD) (8 items), irascibility (IR) (5 items), physical exhaustion (5 items), and negative thoughts (4 items). The Cronbach's alpha reliability values for the reaction subscales were high ($\alpha \geq .83$) (see Table 4).

The Coping-Academic Stress Questionnaire (Coping) (A-CEA; Cabanach et al., 2010) was used to evaluate the cognitive and behavioural strategies used to cope with academic stress situations. It is formed by 23 items answered on a Likert scale 1 (never) to 5 (always). The group of actions was classified in: positive revaluation (PR; 9 items), search for social support (SSS; 7 items), and planning and resource management (PMR; 7 items). Their reliability values are shown in Table 5.

Finally, performance measures were taken from academic performance based on their average grade, while effort was measured through the following self-report question: How would you value your effort and dedication to your studies from 1 (not at all) to 10 (total)?

Procedure

A double statistical analysis approach was followed to identify groups of students, using SPSS v.2022. Both a variable-oriented and a person-centred analysis were applied, to understand how learning patterns are formed, as well as to identify how university students evolve in their learning patterns and how academic stress variables affect this evolution. Each subscale was analysed through its reliability, descriptive data and exploratory factorial analysis in the case of learning patterns components, following the maximum likelihood method and Oblimin rotation. The corresponding indicators were considered: the KMO, Bartlett's test of sphericity, factor loadings greater than .30, and the percentage of the explained variance.

In relation to the person-centred analysis, a descriptive analysis based on the mean score of all variables related to learning patterns (beliefs and strategies) and academic stress (stressors, reactions, and coping) was carried out for both courses (year 1 and 2).

Subsequently, a cluster analysis (K-means) was carried out to identify specific groups of students because it allows group formation based on similar data, while maximises external diversity among groups. Considering that this study used a longitudinal design with these variables for the first time, an exploratory approach to the data was applied, without using any probabilistic modelling and its assumptions. This approach was coherent with the learning pattern model. Finally, the chi-square test was applied to identify groups related to high and low performance, using the mean of each group to define two performance levels in each group-university.

In relation to the student profile that accounts for early university dropout, a correlation analysis was carried out between all the variables that conform the study. To do this, the first year sample was selected and divided into students who dropped out and those who continued.

Ethical considerations

In each participating institution, the ethical body responsible for research integrity reviewed and approved the study, as part of the administrative procedure required for authorising data collection. An invitation letter and a detailed description of the project were sent to all collaborating universities, which granted permission following their internal ethical and data protection protocols. All participants provided informed consent and were assured confidentiality and the possibility of withdrawing at any moment.

Results

From the variable-centred analysis, four learning patterns were identified: (1) Meaning Directed in action (MD/ac), which comprises the actions (strategies) of the MD pattern; (2) Passive-Idealistic (PI) focused on learning conceptions; (3) Reproduction Directed (RD); and (4) Undirected (UD). Based on these patterns and using a person-centred analysis, five groups of students were identified: MD/ac, Flexible (with high scores in all patterns), Average (average scores in all patterns), Passive (low scores in all patterns) and UD.

Regarding the evolution of these groups, the chi-square test showed a significant relationship between all first year and second year university student groups ($\chi^2 = 90.162$; $df = 16$; $p < .01$). First year flexible students became passive or remained the same in the second year, which may reflect difficulties in sustaining diverse regulatory strategies as academic demands increase. Students with a MD/ac profile remained in the same cluster, indicating stability in self-regulated and constructive approaches to learning. The same happened to UD and Average students who maintained their profile in the second year, suggesting consolidation of both less-regulated and moderately regulated learning patterns during early university transition. However, some Average students moved to an MD/ac profile, indicating that moderate initial resources may evolve into more constructive strategies over time. Finally, students with a passive profile moved to the UD cluster, revealing a shift toward disorientation when motivational and regulatory resources are insufficient (see Fig. 2).

About academic stress, three groups of students were identified based on stressors: very stressed ($N = 210$; 45.9%) with high scores in all factors, moderately stressed ($N = 140$; 30.6%) with medium scores, and little stressed ($N = 108$; 23.5%) with low scores. A similar categorization was observed for stress reactions: very affected ($N = 122$; 26.6%),

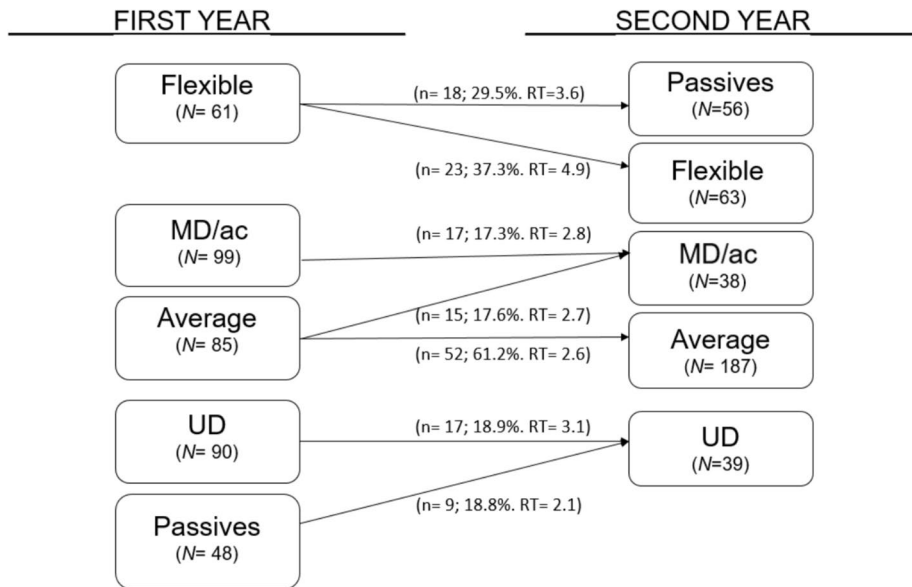


Fig. 2 Evolution of learning patterns in the transition from 1st to 2nd year. *Note: RT, typified residuals

moderately affected ($N=181$; 39.5%), and little affected ($N=155$; 33.9%). Likewise, coping strategies were grouped in three levels: high ($N=95$; 20.7%), medium ($N=207$; 45.2%), and poor coping ($N=156$; 34.1%). However, in the second year, students were grouped differently according to coping strategies. Students with high scores in the strategy of search for social support were classified as passive-behaviour ($N=79$; 17.2%). Students who combined strategies of positive revaluation and planning and management of resources were classified as active-cognitive copers ($N=140$; 30.6%). Finally, students with low scores across all strategies were classified as poor copers ($N=164$; 35.8%).

Concerning effort, three groups were found among first year students: little effort (scores < 6 ; $N=63$; 23%), with medium effort (scores between 6 and 7; $N=128$; 28%), and great effort (score > 7 ; $N=224$; 49%). In the second year, three groups were again identified: low effort (scores < 5.96 ; $N=11$; 2.1%), medium effort (scores between 5.96 and 8.67; $N=221$; 48%), and high effort (scores > 8.67 ; $N=226$; 49.3%).

Finally, in terms of performance, the cluster analysis classified the students into three groups in first year: low (scores < 5.7 ; $N=71$; 15.5%), medium (scores between 5.7 and 8.3; $N=222$; 48.3%), and high (scores > 8.3 ; $N=165$; 36.02%). In the second year, the categorisation was replicated with different scores: low performance (scores < 61.61 ; $N=100$; 22%), medium performance (scores 61.62–82.15; $N=216$; 47%), and high performance (scores > 82.16 ; $N=142$; 31%).

In terms of the relationship between the variables, in the first year, a significant relationship was identified between learning patterns and academic stress including stressors ($\chi^2=20.791$, $df=8$, $p<.01$), reactions ($\chi^2=15.637$, $df=8$, $p<.04$), coping strategies ($\chi^2=32.277$, $gl=8$, $p<.01$), effort ($\chi^2=29.152$, $df=8$, $p<.01$), and performance ($\chi^2=31.831$, $df=8$, $p<.01$). The group MD/ac pattern contributed to the groups of students very stressed, but with high coping, great effort, and high performance. The students with an average pattern were related with little stressed and little affected. The passive students

were related to those little affected and poor coping. The flexible group was linked to high coping and high performance. Finally, the Undirected group was associated with little and medium effort and low performance (see Fig. 3).

Regarding year 2, these relationships between learning patterns and academic stress including stressors ($\chi^2=38.372$, $df=8$, $p<.00$), reactions ($\chi^2=48.936$, $df=8$, $p<.00$), and coping strategies ($\chi^2=61.590$, $df=8$, $p<.00$), as well as effort ($\chi^2=24.548$, $df=8$, $p<.00$) and performance ($\chi^2=121.460$, $df=8$, $p<.00$). The MD/ac pattern in the first year was associated with a group of low-stress students who had coping strategies, worked hard, and performed well academically. Students with an average pattern in the first year were associated with the passive-behavioural coping group and average performance in the second year. Students who initially exhibited a passive pattern were associated with low stress and, surprisingly, high performance. Flexible students were also associated with low stress, but their academic performance was average. Finally, students characterised by an undirected pattern were associated with moderate or very high stress, greatly affected, poor coping skills, average effort, and low performance in the second year (Fig. 3).

Finally, Table 6 shows the relationship between academic performance and the remaining variables using the chi-square test. It evidenced a positive significant relationship in the first year, which was described by students with a flexible pattern and/or the MD/ac pattern, little stressed, high coping strategies, and high effort, while in the second year they became students with an MD/ac pattern or passive students, little stressed, with active-cognitive coping (positive revaluation strategy and planning and resource management) and great effort. On the other hand, low performance was described in the first year with students

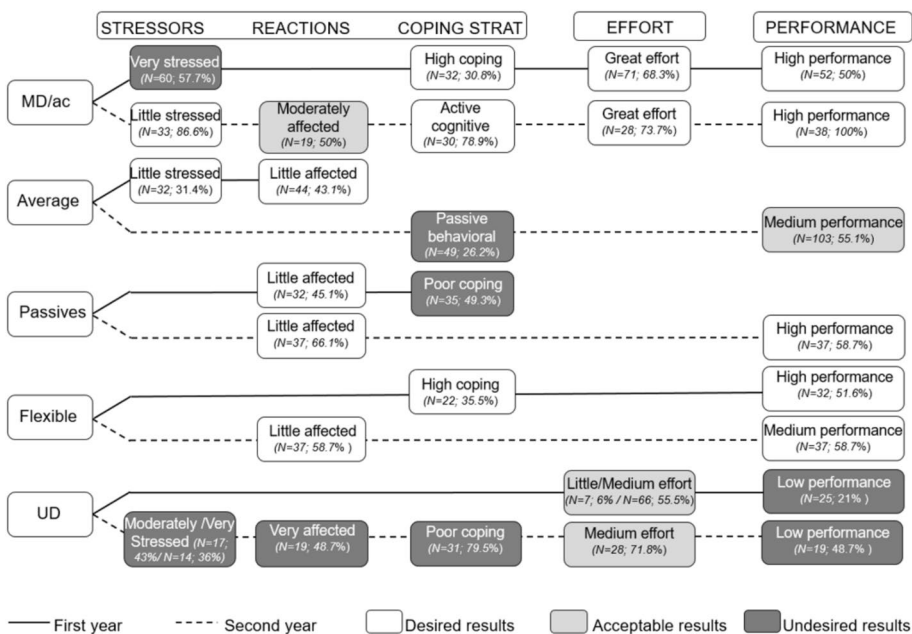


Fig. 3 Relationship between groups of students according to learning patterns, academic stress, effort, and performance in 1st and 2nd year. Note: the acceptability criteria are based on the literature described. Undesired outcomes are those that have a negative effect on academic performance while desired outcomes have positive effects. Acceptable outcomes are related to average performance

Table 6 Relationship between groups of students according to academic performance and learning patterns, academic stress, effort, and performance in the first and second years

Academic performance	Learning patterns $\chi^2 = 31.831$, $df = 8$, $p < .000$					Stress (stress factors) $\chi^2 = 4.474$, $df = 4$, $p < .340$			Affected (reactions) $\chi^2 = 8.322$, $df = 4$, $p < .080$			Coping (coping strategies) $\chi^2 = 15.235$, $df = 4$, $p < .000$			Effort $\chi^2 = 28.941$, $df = 4$, $p < .000$		
	MD/ac	Average	Pas-sives	Flex-ible	UD	Little	M	Very	Little	M	Very	Poor	Medium	High	Little	Medium	Great
<i>First year</i>																	
High ($N = 165$; 36%)	$N = 53$ 50%			$N = 32$ 51.6%	$N = 27$ 22.7%	$N = 47$ 43.5%						$N = 43$ 27.6%		$N = 42$ 44.2%			$N = 103$ 46.0%
Stand- ardised residuals	3.4			2.7	-3.5	1.9						-2.7		1.9			4.3
Low ($N = 71$; 15.5%)	$N = 7$ 6.7%				$N = 25$ 21%				14 9%	$N = 20$ 20.5%				$N = 5$ 5.3%		$N = 49$ 22.3%	18 8%
Stand- ardised residuals	-2.8				1.9				-2.7	1.8				-3.1		3.8	-4.3
<i>Second course</i>																	
High ($N = 142$; 31%)	$N = 38$ 100%		$N = 27$ 48.2%	$N = 12$ 19%	$N = 0$ 0%	$N = 48$ 40.4%			$\chi^2 = 17.546$, $df = 4$, $p < .00$	$\chi^2 = 18.724$, $df = 4$, $p < .00$	$\chi^2 = 34.425$, $df = 4$, $p < .00$	Poor	Passive behav- ioural	Active cogni- tive		$N = 40$ 17.7%	$N = 100$ 45.2%
												$N = 20$ 24.4%	$N = 39$ 23.8%	$N = 74$ 52.9%			

Table 6 (continued)

Academic performance	Learning patterns $\chi^2 = 31.831$, $df = 8$, $p < .000$					Stress (stress factors) $\chi^2 = 4.474$, $df = 4$, $p < .340$			Affected (reactions) $\chi^2 = 8.322$, $df = 4$, $p < .080$			Coping (coping strategies) $\chi^2 = 15.235$, $df = 4$, $p < .000$			Effort $\chi^2 = 28.941$, $df = 4$, $p < .000$		
	MD/ac	Average	Pas-sives	Flex-ible	UD	Little	M	Very	Little	M	Very	Poor	Medium	High	Little	Medium	Great
Stand-ardised residuals	8.9		2.2	-2.9	-4.8	2.4					-2.3	-4.0		5.6		-6.1	6.4
Low ($X = 100$, $N = 22\%$)	$N = 0$				$N = 19$	$N = 22$	$N = 24$	$N = 22$			$N = 25$	$N = 42$		$N = 12$	$N = 6$	$N = 67$	$N = 27$
%					48.7%	10.6%	25.0%	27.8%			30.5%	25.6%		8.6%	54.5%	29.6%	12.2%
Stand-ardised residuals	-3.5				5.3	-4.0	2.1	2.6			3.4	3.5		-3.6	2.7	4.0	-4.8

M, moderately

with a UD pattern, a certain tendency to be very stressed, affected, and with medium effort. In the second year, low performance was assumed by students with a UD pattern, moderate and/or very stressed, very affected, with poor coping and with medium or little effort (Fig. 4). Finally, students with a tendency to dropout ($X = 74$, $N = 16.15\%$) brought together the PI pattern, the stressors of academic obligations and performance, and future perspectives (see Table 7).

Discussion

This research provided a comprehensive view of the evolution of learning patterns during the first 2 years of university studies and their relationship with academic stress and performance in the Ibero-American context. Regarding the first research question, four learning patterns were identified, two of which corresponded to the classic patterns by Vermunt (1998): RD and UD. The other two showed variations: MD in action and the Passive-Idealistic pattern. These results were similar to the findings in Spain (Martínez-Fernández & García-Ravidá, 2012; Vega-Martínez et al., 2023a), Latin America (García-Ravidá, 2017; González & Difabio de Anglat, 2016), and in Ibero-America (Martínez-Fernández & Vermunt, 2015). It is noteworthy that the PI pattern emerged, which is common in secondary school students, suggesting a slow transition to the university context (Vermunt, 2005).

With respect to student grouping based on learning patterns and progression, five groups were identified in the first year: (1) Flexible, combining subscales from all four patterns, as first noted by Donche and Van Petegem (2009) in Northern Europe and later by Rocha and Ventura (2011) in Portugal, where various beliefs, orientations, and strategies were recognised as independently applicable. (2) Meaning Directed in action (MD/ac), aligning with the MD pattern found by Martínez-Fernández and García-Ravidá (2012) in Spain. Although this profile partially diverges from the original model, external regulation remains crucial in certain regions to foster self-regulation; (3) Average students, displaying moderate

HIGH ACADEMIC PERFORMANCE IN THE FIRST YEAR					HIGH ACADEMIC PERFORMANCE IN THE SECOND YEAR				
LEARNING PATTERNS	STRESSORS	REACTIONS	COPING	EFFORT	LEARNING PATTERNS	STRESSORS	REACTIONS	COPING	EFFORT
MD/ac (N=53; 50%)	Little stressed (N= 47; 43.5%)	Little affected	Poor coping	Little effort	MD/ac (N= 38; 100%)	Little stressed (N= 48; 40.4%)	Little affected	Poor coping	Little effort
Average					Average				
Passives	Medium stressed	Medium affected	Medium coping	Medium effort	Passives (N= 27; 48.2%)	Medium stressed	Medium affected	Passive behavioral	Medium effort
Flexible (N=32; 51.6%)	Very stressed	Very affected	High Coping (N= 42; 44.2%)	Great effort (N= 103; 46%)	Flexible	Very stressed	Very affected	Active cognitive (N= 74; 52.9%)	Great effort (N= 100; 45.2%)
UD					UD				
LOW ACADEMIC PERFORMANCE IN THE FIRST YEAR					LOW ACADEMIC PERFORMANCE IN THE SECOND YEAR				
LEARNING PATTERNS	STRESSORS	REACTIONS	COPING	EFFORT	LEARNING PATTERNS	STRESSORS	REACTIONS	COPING	EFFORT
MD/ac	Little stressed	Little affected	Poor coping	Little effort	MD/ac	Little stressed	Little affected	Poor coping (N= 42; 25.6%)	Little effort (N= 6; 54%)
Average					Average				
Passives	Medium stressed	Medium affected	Medium coping	Medium effort (N= 49; 22.3%)	Passives	Medium stressed (N= 24; 25%)	Medium affected	Medium coping	Medium Effort (N= 67; 29%)
Flexible	Very stressed	Very affected (N= 20; 20.5%)	High coping	Great effort	Flexible	Very stressed (N= 22; 27.8%)	Very affected (N= 25; 30.5%)	High coping	Great effort
UD (N= 25; 21%)					UD (N= 19; 48.7%)				

Fig. 4 Relationship between groups of students according to academic performance and learning patterns, academic stress, effort, and performance in the first and second years of university degree. Note: Blank spaces show a non-significant relationship

Table 7 Correlations between academic performance and learning patterns, academic stress, and effort in the first and second year

	<i>First course</i>	<i>Second course</i>	<i>Dropout</i>
<i>Learning patterns</i>			
PI		-.229**	-.257*
MD/ac	.274**	.422**	
RD	.191**	-.322**	
UD		-.436**	
<i>Stressors</i>			
AO	-.195**	-.262**	-.293*
PFP	-.128**	-.130*	-.347**
ID		-.105*	
EC	-.149**	-.223**	
<i>Reactions to stress</i>			
SD			
IR		-.167**	
PE		-.129*	
NT	-.196**	-.188**	
<i>Coping strategies</i>			
PR	.155**	.309**	
SSS		.193**	
PMR	.198**	.266**	
<i>Effort</i>	.260**	.356**	

* $p < .05$; ** $p < .01$; *** $p < .001$

acquisition levels across subscales without a defined learning approach (Vega-Martínez et al., 2023a); (4) Undirected, identified in multiple studies (Biemans & Van Mil, 2008; Boyle et al., 2003); and (5) Passive students, with low scores across patterns, akin to the inactive students described by Rocha and Ventura (2011). In the second course, these same groups persisted, reaffirming that learning patterns follow international trends. This stability allows higher education teachers to better understand student learning behaviours and adapt instructional approaches accordingly.

Regarding groups' evolution, significant changes occurred between first and second year. Flexible students remained in their group or adopted a passive pattern, while some transitioned to the intermediate group. As noted by Donche and Van Petegem (2009) and Rocha and Ventura (2011), flexible students can apply regulation or processing strategies to cope with university demands, albeit with difficulty. Those who struggle more with academic workload management often join the passive group. For this reason, universities should promote the development of coping strategies from the beginning, for example, through mandatory stress management workshops in the first year (Cabanach et al., 2018).

The group of students with the MD/ac pattern remained unchanged in the second year, typically identified with the MD pattern or its variables, such as MD with external regulation (de la Barrera et al., 2010; González & Difabio de Anglat, 2016; Martínez-Fernández & Vermunt, 2015). These findings align with Smith et al. (2010), who noted that the MD pattern is maintained in the early years of university, increasing as students gain academic experience and develop stronger patterns, particularly the MD pattern (Vermunt, 2005).

González and Difabio de Anglat (2016) suggested this is mainly due to the acquisition of self-regulation strategies. Another explanation is that MD-pattern students tend to stay in university, while those with less developed patterns are more likely to drop out, leading to a higher concentration of MD students over time (de la Barrera et al., 2010). Regardless of the cause, literature evidenced that the MD pattern remains consistent, strengthens, and/or increases in the later years of university (Boyle et al., 2003; de la Barrera et al., 2010; González & Difabio de Anglat, 2016; Smith et al., 2010; Vermunt & Minnaert, 2003). Thus, an in-depth analysis of MD-related variables could be valuable to explore how they might help address long-term dropout situations in UD-pattern students.

On the other hand, some of the average students group maintained, whereas others acquired the MD pattern. The findings reinforce the contributions of Donche and Van Petegem (2009), stating that students who enter university and do not have a clear and defined idea of their learning process generally end up acquiring an MD pattern, which can be presented during the third course; thus, these changes could already be seen in the second year. However, this research also identifies that, for this to happen, students must have a certain level of self-regulation. Otherwise, the predominance of external regulation promotes great difficulties in acquiring this change.

The group of students with an Undirected (UD) pattern remained in the second year, with passive students joining. In fact, Rocha and Ventura (2011) classified the UD pattern as passive due to its low scores on pattern subscales. However, its presence in the year 2 decreased by more than half, as observed by Donche and Van Petegem (2009) and González and Difabio de Anglat (2016). Moreover, Martínez-Fernández and García-Ravidá (2012) and Vermunt and Minnaert (2003) noted that UD students tend to acquire an RD pattern, which, according to Vázquez (2009), results from rehearsal strategies, memorisation, and certificate-oriented motivation. Similarly, de la Barrera et al. (2010) suggested this process can occur regardless of the original pattern, particularly in Social Sciences. Nonetheless, no evidence of this was found in the present study.

In terms of other variables, learning profiles showed clear differences in stress management, effort, and academic performance. Specifically, MD/ac students excelled in self-regulation and deep processing, which enhanced their academic performance. In addition, they applied active coping strategies, such as planning and resource management, to mitigate academic stress (Vega-Martínez et al., 2023b). Notably, self-regulation allows them to control emotional and cognitive reactions to challenges (Martínez-Fernández & Vermunt, 2015; Higgins et al., 2021; Vermunt, 2005). Consequently, this resilience enables sustained effort and high performance (Kyndt et al., 2017). Furthermore, stress reactions in this group are milder, with lower physical exhaustion and negative thoughts, which facilitates a smoother transition to university (Cabanach et al., 2018; Jurado-Botina et al., 2021).

On the other hand, average students struggled with stress management, which negatively impacted their effort and performance (García-Ros et al., 2012). More importantly, their weaker self-regulation led to stress reactions that impaired concentration and motivation (Cabanach et al., 2018; de la Fuente et al., 2020; Taboada, 2015). Likewise, passive students, who scored low on all subscales, experienced high stress, severe reactions, and reduced motivation and effort (Holgado et al., 2019; Restrepo et al., 2020; Suárez-Montes & Díaz-Subieta, 2015). In this regard, Montiel-Cortés et al. (2020) argued that without strong self-regulation, these students struggle to manage academic demands, increasing their dropout risk.

Undirected students, however, faced the greatest difficulties due to minimal regulation and reliance on superficial processing. As a result, they experienced intense stress

reactions, including extreme exhaustion and hopelessness (Vega-Martínez et al., 2023a; de la Fuente et al., 2020). Worse still, their inability to self-regulate exacerbated their lack of control over learning, perpetuating low performance and stress, which further increases their likelihood of dropping out (Jurado-Botina et al., 2021; Trigueros et al., 2020). In contrast, flexible students, who blended different patterns and possessed strong self-regulation, adapted better by adjusting coping strategies. Therefore, they managed to maintain medium-high performance even under stress (García-Ravidá, 2017; Cabanach et al., 2018; Ramos et al., 2020). In any case, the overlap of the constructs identified in this study requires expanding quantitative analyses with techniques that allow the effect of specific variables to be isolated. Similarly, additional qualitative techniques are necessary to complement these analyses in authentic teaching and learning settings.

The conclusions partially supported hypothesis 1. Students with the MD pattern increased in the first 2 years, showing a positive relationship with coping, effort, and good performance. However, the AD and RD profiles were not identified, which contradicted the hypothesis. As for students with the UD pattern, no transition to the RD pattern was observed; instead, they remained in the same pattern over time, which was associated with higher levels of stress, reactions, and lower performance.

In sum, the results identified the evolution of patterns during the first 2 years of university (Vermunt, 2005), as well as a clear relationship between learning patterns, academic stress, and performance (Vega-Martínez et al., 2023a). However, further exploration is possible through the identification of profiles that characterise high and low performance, as well as with university dropout. Addressing the second research question, we found that high academic performance was described by students who managed to combine self-regulation and stress-coping strategies from the first years of university. These students, identified with characteristics of the Meaning Directed in Action (MD/ac) profile, were not only able to mitigate the effects of initial academic stress but also employed deep processing strategies that enhanced their adaptation and success in the second year (Martínez-Fernández & Vermunt, 2015). It is inferred that their sustained effort acted as a key catalyst, in line with Vega-Martínez et al. (2023a), allowing them to reach higher levels of performance even in the face of the most complex academic demands. Likewise, as Taboada (2015) suggested, the combination of these skills with a resilient and reflective attitude supports their transition to the university environment.

Low academic performance at university seemed to be related to students who had significant difficulties in self-regulating their learning and employing effective coping strategies. It is intuited that these students, associated with the UD profile, tended to use superficial processing strategies, which limited their ability to respond adequately to academic challenges. As suggested by de la Fuente et al. (2020), this lack of regulation aggravated their vulnerability to academic stress, manifesting symptoms such as physical exhaustion and negative thoughts. According to Holgado et al. (2019), these negative reactions could intensify their perception of incapacity, perpetuating a cycle of low performance and stress that compromises their permanence at the university.

Finally, university dropout was commonly associated with students who, although they held certain beliefs about the importance of learning, failed to translate them into concrete actions. This phenomenon, described as characteristic of the Passive-Idealistic profile, seems to be linked to a slow transition towards university demands, largely due to the persistence of learning patterns rooted in previous educational stages (García-Ravidá, 2017). Taken together, the results indicate that difficulty adapting to university teaching methods, as reported by Martínez-Fernández and García-Ravidá (2012), contributes to an increased risk of dropout, particularly within the first 2 years of study. In line with

Kyndt et al. (2017), interventions that foster early development of self-regulation and coping skills could meaningfully lower dropout rates among these students.

In this regard, the conclusions partially supported hypothesis 2. The MD pattern, associated with high performance, showed that students combined self-regulation and coping strategies. In contrast, the UD pattern, linked to low performance, was characterised by difficulties in self-regulation, superficial processing, and high stress. However, no clear connection was found between the UD pattern and university dropout, suggesting that further research is needed to clarify this relationship.

Nonetheless, as the research progressed, various limitations became apparent. Institutional demands varied among universities, even when they shared the evaluation methods. Also, average grades did not consistently capture the true level of learning, and comparisons of stress were difficult considering the wide range of measurement instruments used. Most notably, the study relied exclusively on self-report inventories. Although the theoretical models are robust and the instruments demonstrate adequate reliability and validity, additional measures (e.g. interviews and observations) would help refine our understanding of learning patterns.

In conclusion, this study implies that universities should adopt some guidelines addressed to all students, aiming at improving the learning processes and their academic outcomes quality, together with reducing academic failure as much as possible. These include (1) increasing awareness of the challenges of university learning; (2) designing cross-disciplinary workshops that provide students with the necessary skills; (3) identifying learning patterns to offer assistance, support, and monitoring of the necessary changes in approach to study; and, in conjunction with this, promoting (4) critical thinking, (5) stress management, and (6) a culture of effort. All of this because we found evidence that students with a MD/ac pattern with strategies for coping with academic stress and effort related to better performance and pursuit of studies. Furthermore, teaching should prioritise the design of personalised learning itineraries that account for student differences within truly inclusive practices.

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Data availability Data is available upon reasonable request.

Declarations

Ethics approval and consent to participate Regarding ethical aspects, the corresponding administrative procedures were conducted to obtain the necessary permissions for data collection, obeying the regulations of each country to guarantee the anonymity of the participants. In addition, an invitation letter accompanied by a document describing the research project was sent to each university, which was evaluated and accepted by the ethics committees or equivalent in each of the participating universities.

Conflict of interest The authors declare no competing interests.

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Current themes of research:

Currently, our research group is focused on examining the evolution of learning patterns and the development of research competence throughout the academic trajectory at university. As demonstrated by the presented publications, our work explores learning styles, the impact of learning and regulation strategies, and research competence, employing a variable- and person-centred analytical approach.

Most relevant publications in the field of Psychology of Education:

Some of the most relevant publications are considered to be the following:.

- Shum, A., Fryer, L., Vermunt, J. D., Ajisuksmo, C., Cano, F., Donche, V., Law, D., Martínez-Fernández, J. R., Van Petegem, P., & Yu, J. (2024). Variable- and Person-centred meta-re-analyses of university students' learning strategies from a cross-cultural perspective. *Higher Education*, 87(5), 1227–1250. <https://doi.org/10.1007/s10734-023-01062-4>.
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