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The learning patterns model in Primary Education: a mixed methods approach

El modelo de patrones de aprendizaje en Educación Primaria: una aproximación con métodos mixtos

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Abstract

Understanding students' learning patterns involves identifying their conceptions about school, their motivations and their strategies. Although the literature on learning patterns has focused on higher education, some studies have already demonstrated the relevance of the theoretical model in primary education, although they point to the need for adaptations to ensure its correct adaptation to the corresponding educational stage. Using a mixed methodology, this research explores the structure of the model at this stage; the Inventory of Learning Patterns of Students was used with 218 students and a qualitative approach was incorporated with a subgroup of 25. The results show the presence of a profile of students with an undirected pattern; however, there is a group that does not yet have a clearly defined pattern. The qualitative contributions provide a better understanding of the meaning given by students to the elements of the model. A structure similar to the original model is observed in terms of regulation strategies, while different conceptions, motivations and processing strategies emerge, although these are compatible with the theory. New elements to be considered in adapting the theoretical model of learning patterns to this stage are identified, including emotional aspects, as well as conceptions and expectations regarding the family. These findings emerge from the qualitative contributions, which are fundamental for a richer description and explanation of the data on learning processes.

Keywords: learning; learning process; primary school pupil; motivation.

Resumen

La comprensión de los Patrones de Aprendizaje del alumnado implica la identificación de sus concepciones acerca de la escuela, sus motivaciones y sus estrategias. Si bien la literatura en patrones de aprendizaje se ha centrado en la Educación Superior, algunos estudios ya han evidenciado la pertinencia del modelo teórico en la Educación Primaria, aunque manifiestan la necesidad de adaptaciones, garantizando su correcta adaptación a la etapa educativa correspondiente. Mediante una

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metodología mixta, esta investigación explora la estructura del modelo en esta etapa; se utilizó el Inventory of Learning patterns of Students con 218 estudiantes y se incorporó una aproximación cualitativa con un subgrupo de 25. Los resultados muestran la presencia de un perfil de estudiantes con patrón no dirigido; sin embargo, existe un grupo que todavía no presenta un patrón claramente definido. Las aportaciones cualitativas permiten comprender mejor el significado otorgado por el alumnado a los elementos del modelo. Se observa una estructura parecida al modelo original en cuanto a las estrategias de regulación; mientras que emergen concepciones, motivaciones y estrategias de procesamiento distintas, aunque compatibles con la teoría. Se identifican nuevos elementos a considerar en la adaptación del modelo teórico de patrones de aprendizaje a esta etapa, entre ellos los aspectos emocionales, así como las concepciones y expectativas respecto a la familia. Estos hallazgos emergen de las aportaciones cualitativas, que son fundamentales para una descripción y explicación más rica de los datos acerca de los procesos de aprendizaje.

Palabras clave: aprendizaje; proceso de aprendizaje; estudiante de primaria; motivación.

Introduction

Learning processes are a key aspect of the academic and personal trajectory of the learner, and learning is the conjunction, whether congruent or not, of beliefs and actions. This premise guided Vermunt (1998) in formulating the model of learning patterns, taking into account four components: conceptions of learning, motivational orientation, regulation strategies, and cognitive processing.

The learning pattern (hereinafter LP) is defined as the relatively stable way in which a student understands what learning means, why they do it and how (Vermunt, 1998). Initially, the existence of four patterns was postulated: meaning-directed (MD), application-directed (AD), reproduction-directed (RD), and undirected (UD). The key processes for meaningful learning are related to the elements of the MD pattern: constructive beliefs about learning, activated by personal interest, with self-regulation and deep processing. The RD pattern involves a conception of learning as the accumulation of information, motivated by the attainment of grades and certificates, with external regulation and surface processing. The AD pattern understands learning as the use of knowledge, vocationally oriented, self- and externally regulated with concrete processing. Finally, the UD pattern is based on a conception of stimulated learning, with ambivalent orientation, absence of regulation, and limited processing.

The PA model has been widely used in higher education, based on the application of a self-report questionnaire (Inventory of Learning Patterns of Students, ILS). It has demonstrated solid evidence of validity (Martínez-Fernández, 2019; Shum et al., 2024; Vermunt and Donche, 2017; Vermunt and Vermetten, 2004), although it calls for the use of other materials that provide a more in-depth and comprehensive view of the characterisation of learning patterns (Vermunt, 2020). Although little explored in primary education (Martínez-Fernández et al., 2017, 2021), this theoretical model, useful for understanding learning processes, can serve as a basis for developing learning to learn competence and designing appropriate educational activities (Bonanomi et al., 2020; Ruiz-Bueno and García-Orriols, 2019).

This gap in the literature seems to be justified, in the words of Vermunt and Vermetten (2004), by the fact that younger students do not differentiate their strategies, conceptions, and orientations as precisely. Similarly, Kikas and Jõgi (2016) venture that students under the age of 16 may not be able to adequately answer questions that require a general description of their study activities.

However, there is empirical evidence about self-regulatory activities in primary education and their effect on self-efficacy beliefs and academic achievement (Sáez-Delgado et al., 2024). It has been observed that from an early age, beliefs and theories about knowledge and learning are developed that can be verbalised (Elder, 2002; Scheuer et al., 2006), although they only become effective towards the end of the stage (Dignath et al., 2008). The literature indicates that primary school pupils are competent in self-regulation; they only require clear instructions for planning and control from teachers (Torrington et al., 2023). Recently, Vermunt et al. (2023) added that this is possible as long as teachers have an adequate, and unproblematic, learning pattern. Likewise, other studies show the key role of family relationships in the early activation of self-regulation (Xia, 2024).

Thus, the difficulty of studying the learning processes of younger students could be due, in part, to methodological issues inherent in the way this information is collected and their beliefs, motivations and strategies accessed. To this end, Martínez-Fernández et al. (2017, 2018) propose a mixed method for identifying SLs,

triangulating the information collected using the ILS with data from classroom observations and interviews with tutors.

For all these reasons, there is interest in exploring the LP model in primary education with the aim of providing elements for adapting the model and the instrument to this stage of development and education. The research raises the following research questions:

1. To what extent does the structure of the ILS scores applied to a sample of primary school pupils correspond to the theoretical structure of the learning patterns model?
2. What other specific elements emerge in the students' discourse that should be considered in adapting the model and the ILS for this educational stage?

In short, the study aims to collect, by integrating different methodological approaches, evidence of validity based on the internal structure of the scores of an adaptation of the ILS, applied to primary school pupils; and based on content, thanks to qualitative contributions extracted from discussion groups, which illustrate how they understand and specify the constructs of the model (in line with Vogt et al., 2004).

Methodology

Mixed design

To answer the research questions, a sequential explanatory mixed study (S-QUANàqual; Creswell, 2022) was proposed. The first quantitative phase aimed to answer the first research question through factorial and cluster analysis of the scores collected in the ILS; and the second qualitative phase focused on the second question, complementing and refining the previous results.

Participants

Three public primary schools in the Region of Murcia participated, voluntarily joining the research and its possible transfers. All students in the 4th, 5th, and 6th grades at these schools were invited to participate, considering that the minimum age for this adaptation of the ILS is 9 years old. The overall sample consisted of 218 students (53.2% boys and 46.5% girls), distributed among 4th, 5th and 6th grades (32.1%, 35.8% and 32.1%, respectively).

In addition, a subsample was selected for qualitative data collection. Based on accessibility criteria, one of the three schools was chosen to be the focus. Here, 25 students who were still at the school were able to participate: 14 girls and 11 boys, from the 5th (14) and 6th (11) grades.

Strategies and instruments

The *Inventory of Learning Patterns of Students* (ILS) adapted for primary education (Martínez-Fernández et al., 2015) was used to collect quantitative data. The questionnaire consists of 60 items (available in the supplementary material), to be assessed on a three-point scale, distributed evenly across the four components evaluated by the model: conceptions of learning, motivational orientation, regulation strategies and cognitive processing. It should be noted that this version of the ILS has shown evidence of reliability in previous studies (Martínez-Fernández et al., 2017, 2018; Martínez-Fernández, 2019), although evidence of validity in the specific population of primary school students has not yet been sought.

Qualitative data were collected using the focus group technique, understood, following Ibáñez (1986), as a discursive situation in which the group produces, orders and structures collective discourse around the topic under discussion. In line with the second research question, an attempt was made to encourage interaction in which the participating students could rework their points of view with the rest of the group members, with the aim of generating a wide range of ideas and experiences with which to enrich the model. Therefore, the script design was open, structured around three themes, but flexible so that the dialogue could flow.

The group session was designed in three parts. After a brief presentation of the study, the conversation focused on conceptions: students were invited to think about how they imagined learning, education, study, among other things. In the second part of the session, motivations were addressed: through questions about their experience in

different subjects, students were asked to express the reasons that activate their learning. The third part explored their regulation and processing strategies, with questions more focused on the actions they take to learn, plan, regulate their efforts, etc.

Procedure

The project was registered at the research group's university through an agreement specifying the ethical aspects of the study. Specifically, it was decided to: 1) assign a pseudonymisation code known only to the person coordinating the fieldwork; 2) request oral consent from the children participating in the discussion groups; 3) not to publish the transcripts, given that the information shared in the groups could be easily identified by the school's teaching staff; and 4) to return the quantitative results to the children at the end of the discussion groups, as well as to the teaching staff at the end of the project. The schools approved the research procedures and took responsibility for obtaining informed consent from the families.

With regard to the fieldwork, the students responded individually to the ILS in a group session, under the guidance of a member of the research team. The approximate time taken to complete the questionnaire was 20 minutes. Subsequently, three discussion groups were held, involving 6, 9 and 10 students, respectively. In forming the groups, a balance was sought between criteria of homogeneity and heterogeneity, considering the school year, gender and learning patterns identified in the quantitative phase.

Each session lasted approximately one hour and incorporated playful tasks such as collage and drawing, which encouraged participation and expression beyond verbal skills (París and Hay, 2019). Works of art were also used, selected for their thematic variety, colours, styles, degrees of abstraction, emotions they could evoke, among other aspects. Based on the students' selection and reworking of these works, spaces for dialogue were created around their conceptions, motivations, and actions. The facilitation, which was not very directive, focused on provoking reflection on the proposed topics and maintaining an open space for free expression, with intense but respectful interactions.

Data analysis

The quantitative analysis process focused on collecting evidence of the validity and reliability of the scores.

First, exploratory factor analyses (EFA) were performed using the FACTOR 10.8.02 programme; on the polychoric correlation matrix, the RULS extraction method and Promin oblique rotation were used. To assess the fit, the significance of the robust chi-square adjusted for mean and variance was inspected, as well as the standardised residual histogram, looking for an approximately normal distribution, and an RMSR value below .08. The NNFI, CFI, and RMSEA indices were taken into consideration, setting a lower limit of .95 for the NNDI and CFI, and an upper limit of .05 for the RMSEA.

Once the factors that would constitute the ILS subscales had been defined, different coefficients of precision and quality of the scores were calculated: α, considering the items that saturate the factor to a greater extent; and three indices proposed by Ferrando and Lorenzo-Seva (2017): H-Latent, FDI, and ORION.

To identify the PAs, a cluster analysis was performed using EAP estimates for each factor, with the Jasp 0.17.1 programme, using the unsupervised machine learning technique of random forest; 1000 training trees were set and the number of clusters was established based on the emerging results and the interpretability of the solution.

As for the qualitative data, the transcripts of the discussion groups were transferred to the ATLAS.ti 8.0 programme for categorisation. The ILS subscales were defined as categories, and inductive codes were added to collect, within each component, elements that could describe another conception, orientation or strategy. The final category system is shown in Table 1.

Table 1

Categories used for qualitative analysis .

Dimension	Category	Definition	Frequency of citations
Conceptions of learning	Cooperative learning	A view that places great importance on peers, considering learning to be something that must necessarily be done with the help of other people.	3
	Knowledge construction	Learning as a reflective activity, where the individual generates relationships and assigns new meanings.	2
	Teacher stimulation	Learning as a process triggered and supported by teachers.	8
	Increase in knowledge	Learning as an accumulation of information that must be absorbed.	2
	Use of knowledge	Learning as the implementation of knowledge, devising new applications.	4
	Other elements linked to concepts	Inductive category	12
Learning guidelines	Certificate orientation	Motivation towards grades and passing exams.	6
	Ambivalent orientation	Doubts about motivation to learn, the value of studying, or one's own ability to succeed.	0
	Vocational orientation	Motivation towards developing a profession.	0
	Personal interest	Motivation that comes from desire, a love of learning, and the belief that it is an enriching task.	8
	Self-assessment	Motivation that comes from the desire to test oneself and others on one's own abilities.	1
	Challenge	Inductive category: motivation to learn aimed at accomplishing a difficult task, which represents a demonstration of one's abilities.	4
	Other elements linked to orientations	Inductive category	5
Regulation strategies	Absence of regulation	Lack of control in the learning process.	1
	Self-regulation	Activation of strategies to plan, direct and evaluate one's own learning activity.	13
	External regulation	Use of external sources (study materials, teacher guidance, assigned tasks, etc.) to regulate the learning process.	12
Processing strategies	Concrete processing	Learning strategies based on relating content to situations from one's own experience.	0
	Deep processing	Complex thinking strategies involving critical relationships between different types of knowledge.	8
	Superficial processing	Learning strategies based on memorisation, repetition and analytical division of the material to be learned.	10

Note: The definitions of the deductive categories are based on Vermunt's proposal (1998). The inductive categories included under 'other elements linked to conceptions' and 'other elements linked to orientations' contain quotes that refer to various aspects not covered in the initial theoretical model, which are too heterogeneous to constitute solid constructs. In contrast, the inductive category "challenge" groups together quotes that can be interpreted as a specific orientation, which also emerges in the structure of the quantitative results and in the specialised literature (this is discussed further in the results and discussion sections below). The definition of this category is based both on the contributions of the students in the discussion groups and on the factorial structure emerging from the quantitative data obtained through the ILS.

Once the categorisation was complete, the meanings assigned to each category were described based on the content of the quotes, looking for representative examples. The images chosen and created by the students were used as support to understand the conversations generated from them and to report the contribution in a complete and authentic manner.

Results

The quantitative and qualitative results are presented in an integrated manner. First, the results regarding the structure of the model in its four dimensions are reported; next, the results regarding the configuration of the PAs of these primary school students are presented.

Identification of subscales by component

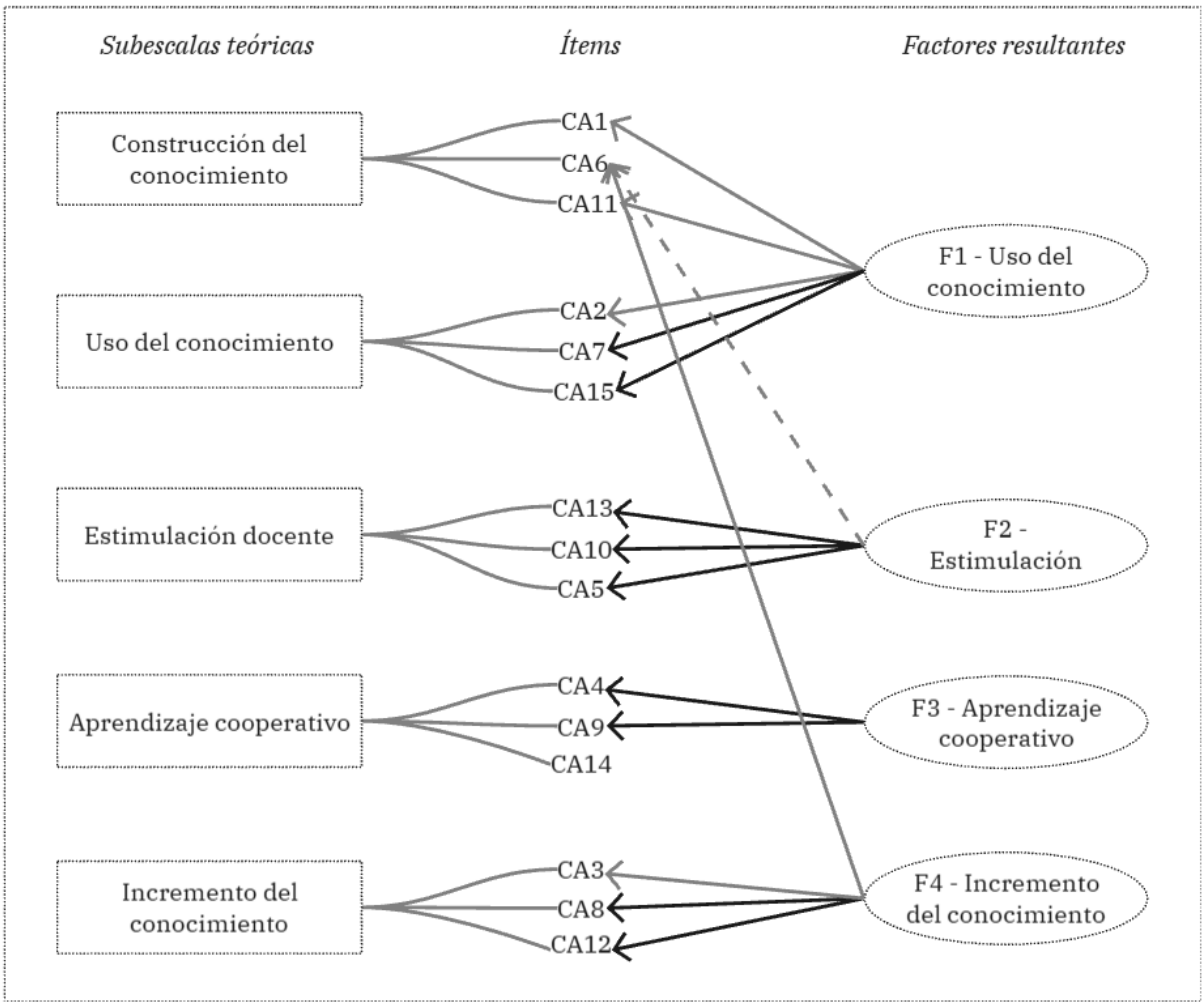
The detailed results of the AFEs are available in the supplementary material: the factor loadings matrices, the fit indices, as well as the variance explained by each factor and the indicators of accuracy and quality of their scores; a summary contrasted with the qualitative contributions is presented here.

Conceptions of learning

The conceptions of learning, collected from 15 items, were grouped into 4 factors (54.4% of the explained variance).

Figure 1

Theoretical grouping of the items of conceptions and factors resulting from the CFA.



Note: Grey arrows indicate saturations greater than .300 in absolute value and black arrows of a more intense colour indicate saturations above .500; dotted arrows represent negative saturation.

Based on the saturations of the items in the factors (Figure 1), these were defined as follows. The first factor is called use of knowledge and incorporates elements of the concept related to one's own active role in reworking content and understanding the problems that arise. The second factor refers to the need for teacher stimulation. The third corresponds to the concept of cooperative learning, particularly the items about asking for help and receiving advice. Finally, the fourth factor consists of the three items on learning as an increase in knowledge, to which is added an item on knowledge construction related to the independent consultation of materials.

The concept that emerged most frequently in the discussion groups was that related to teacher stimulation, identifying the support of teachers (and also family members) as a motivating factor, encouraging students to try harder.

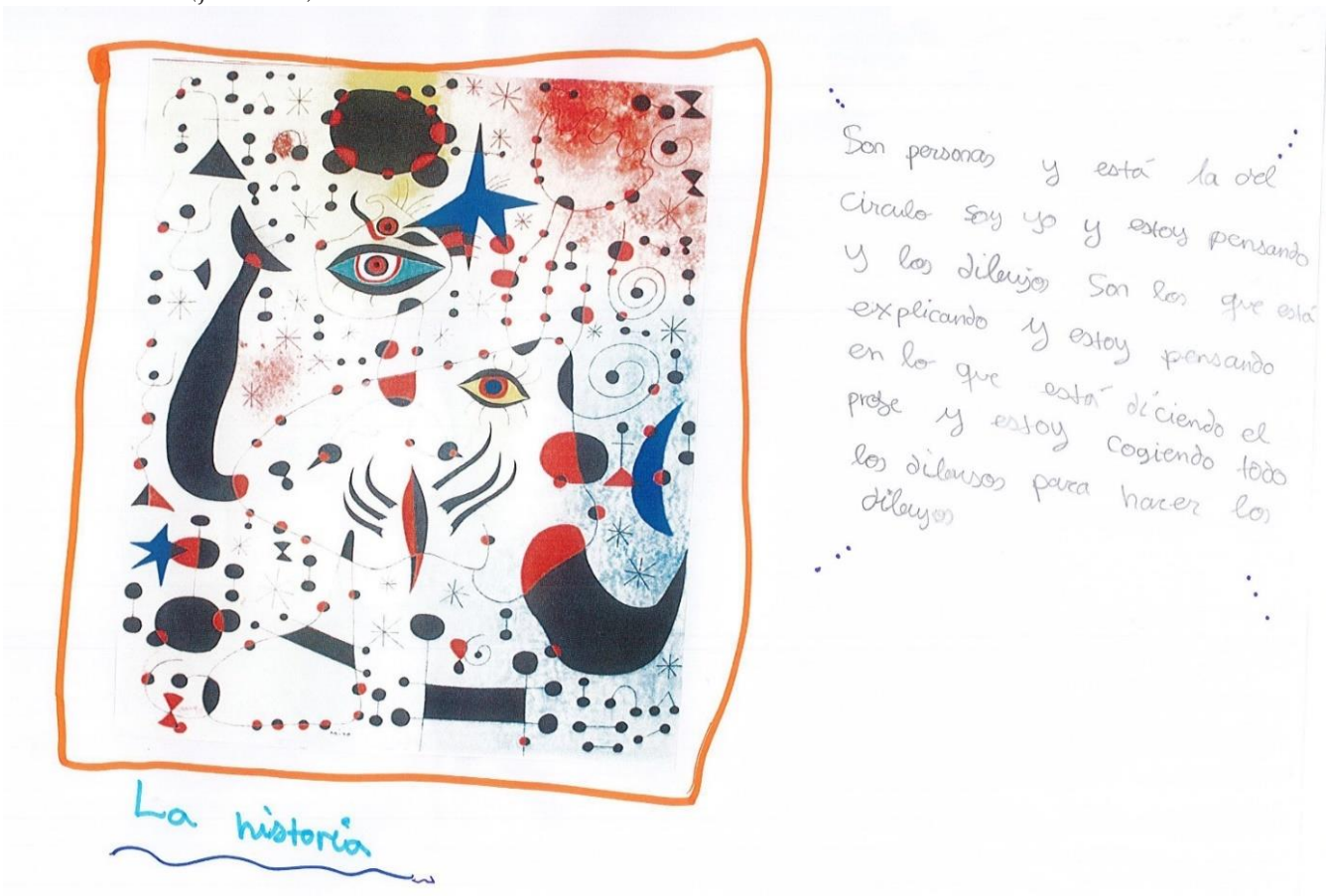
The concept of learning as the use of knowledge is also reflected in the students' contributions. With regard to academic learning, for example, one student comments: "It's about whether it's something we're going to use in everyday life and whether it's going to be useful to us, because obviously, if you're going to learn something you're never going to use, there's no point..." (4X_08_06, GD3).

On the other hand, there is also the concept of increasing knowledge, of learning as an accumulation of information to be absorbed: "When we learn it, it's because they don't teach it, because we didn't know it. But studying it means we already know it, we have to study it even more. More information." (unidentified voice, GD1).

The active role in the learning process and a concept related to construction is shown in contributions such as the one reported in Figure 2.

Figure 2

"Constellations" (Joan Miró)



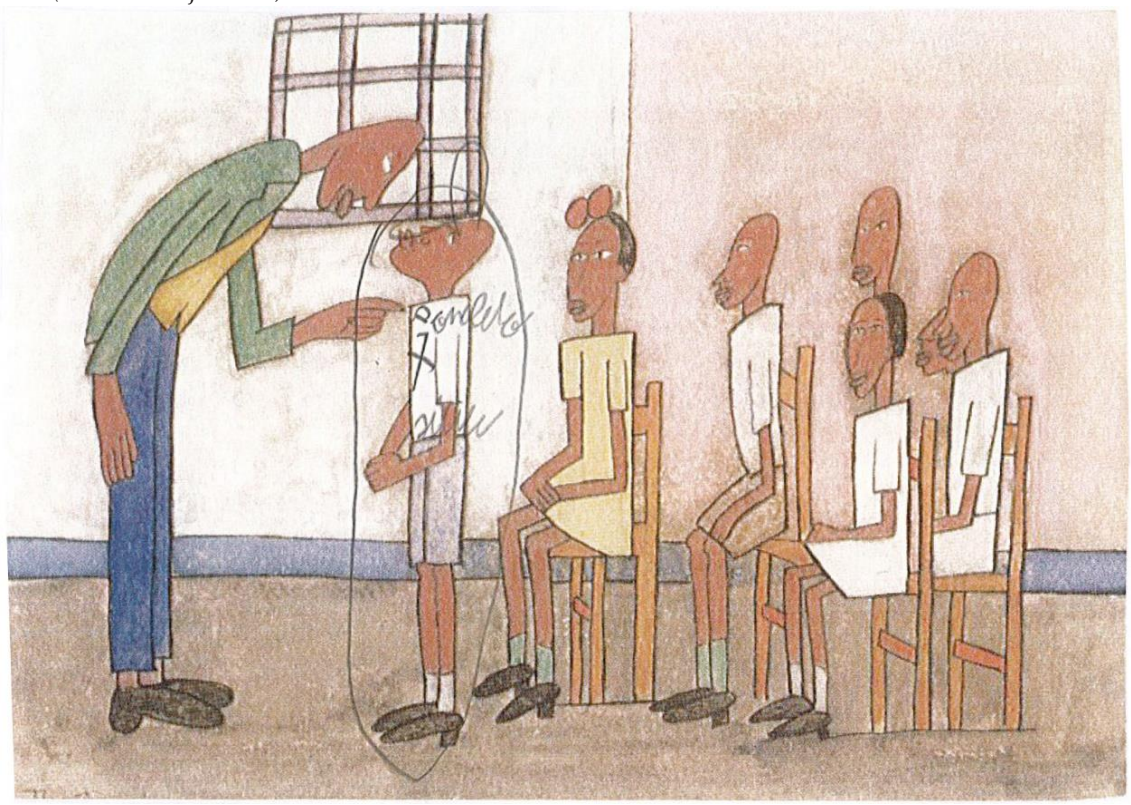
Note. Image chosen to represent learning (4X_01_06, GD3)

Other students express a passive conception of the learner. Images illustrating students "sitting nicely, listening to the teacher" (5X_13_06, GD2) are common, as are contributions such as the following (illustrated in Figure 3):

> Here I am, the teacher has to bend down because I'm short... I'm really good at football, I've got Ronaldo's number 7 [...]. Let's see what he says. And the teacher seems to be telling me off a bit for not bringing my homework. (4X_15_06, GD3)

Figure 3

"The teacher" (William H. Johnson)



Note. Image chosen to represent learning (4X_15_06, GD3)

Other elements related to the learning process also emerged that cannot be unambiguously associated with one of the conceptions of the PA model. In some cases, they refer to emotions, such as: "And I'm thinking about learning [...] there are sad, angry, happy, serious, surprising moments. [...] It's quite a surprise." (5X_12_06, GD1).

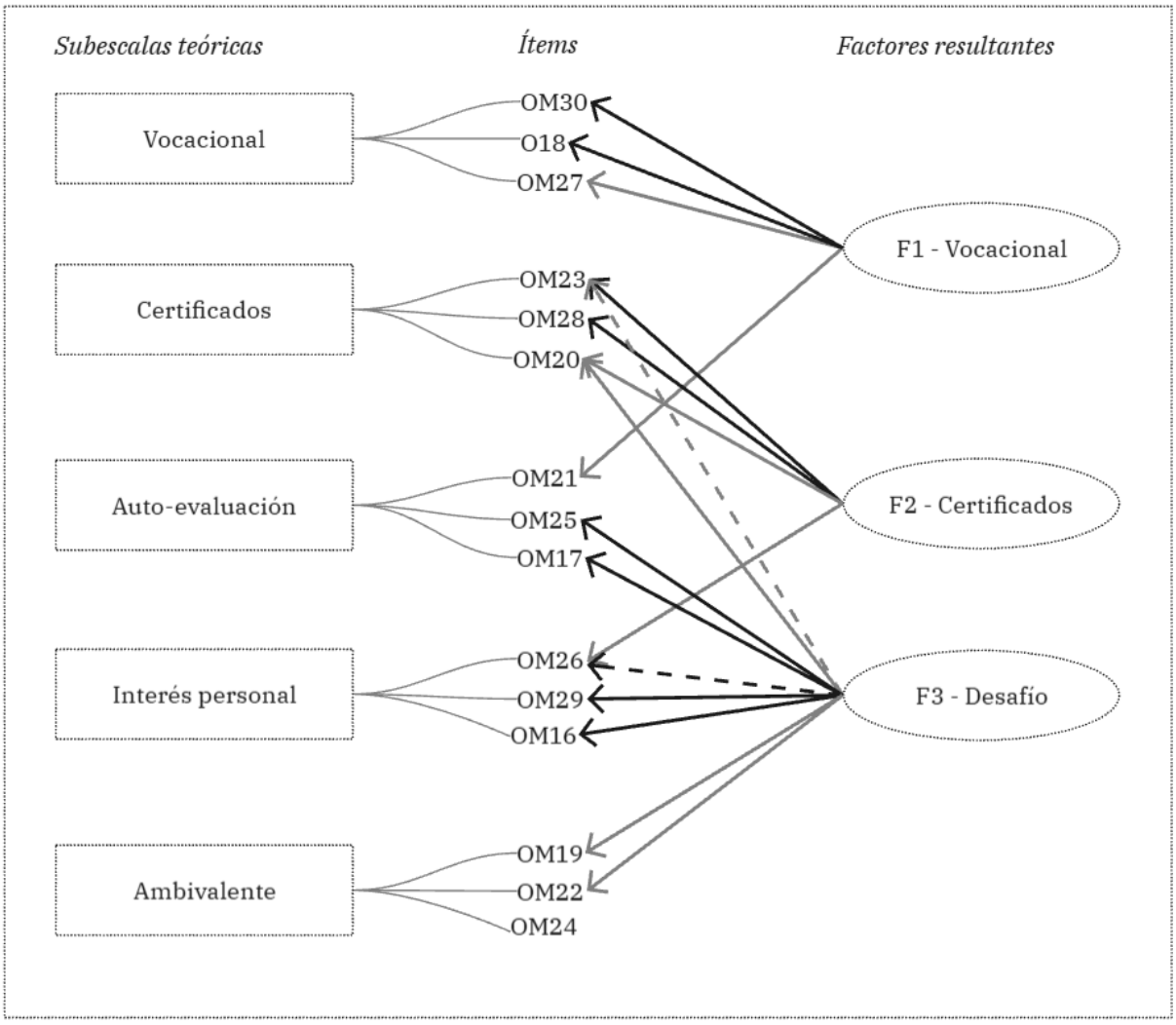
This heterogeneity or variety of learning often appears in the discussion groups; it is commented that learning is a mixture of boring and fun elements, being with friends and teachers, different subjects and even different contexts.

Learning orientations

For the CFA of the items related to learning orientations, a 3-factor solution was chosen (Figure 4), which together explain 51.78% of the variance.

Figure 4

Theoretical grouping of orientation items and factors resulting from the EFA.



Note: Grey arrows indicate saturations greater than .300 in absolute value and black arrows and more intense colours indicate saturations above .500; the dotted arrow represents a negative saturation.

Upon examining the factor loadings matrix, a first factor is identified which, based on the theoretical model, is defined as vocational orientation. The second factor groups the three items on orientation towards certificates, therefore, the original name is also retained in this case. The third factor presents a mixture of self-assessment, personal interest, and questions originally associated with ambivalent orientation: based on the content of the questions, this factor was named challenge orientation and is defined as a motivation to learn aimed at overcoming a challenge, accomplishing a difficult task, which represents a demonstration of one's own abilities.

During the discussion groups, personal interest, certificate orientation and challenge orientation emerged with some intensity, but so did other motivational elements.

Among the students' responses, personal interest is mentioned as a motivation that arises from their own relationship with the content, the subject matter: "Sometimes we have to study something and we don't want to. And sometimes we do, we like it, we feel like it. And when we feel like it, time flies by, and when we don't, it doesn't, of course" (5X_12_06, GD1).

A wide variety of perspectives on the orientation towards certificates emerge: for example, considering grades as an end in themselves, achievable by completing a series of tasks to be handed in so as not to receive a "fail"; but also as a materialisation of the effort made, a reward in itself, or a means of obtaining compensation from the family.

Contributions related to self-assessment and challenge orientations are also identified (Figure 5):

> This is me, and it's a giant mountain. With strange shapes. And here I am climbing this mountain. I've climbed it. [...] I've put myself on a mountain because it's like you're doing something you'll never do in your life. A challenge, something you set yourself. (5X_03_06, GD3)

Figure 5

Excerpt from "On White II" (Vasili Kandinski).

Note. Image chosen to represent the challenge of learning (5X_03_06, GD3)

In some cases, this motivation even seems to be part of a strategy for regulating effort and time: "When I do my homework, I say, look, let's see, how many songs will it take me?" [...] "And while I finish my homework, I put on songs to see how long it takes me." (4X_15_06, GD3).

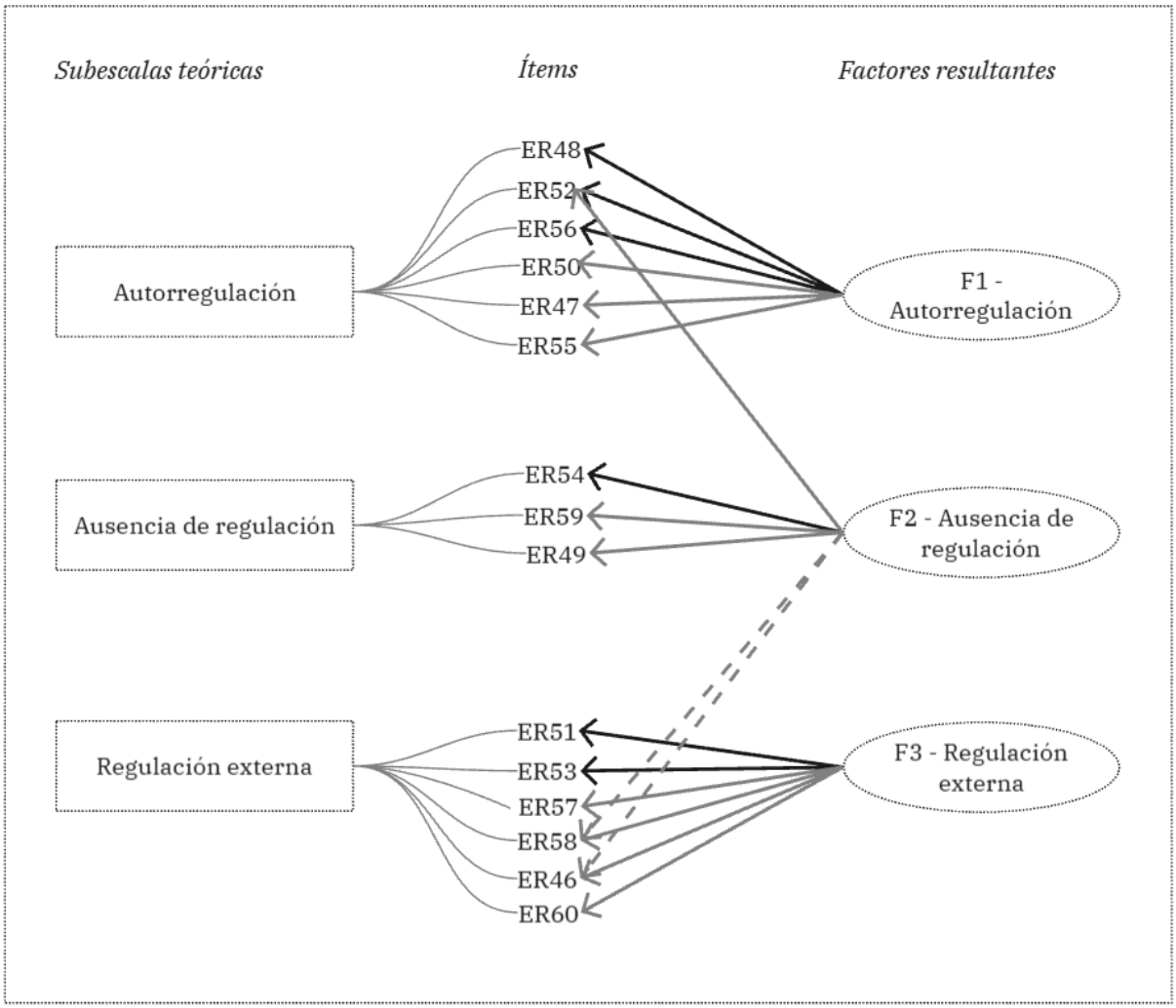
Finally, a motivation related to external rewards emerged: prizes offered in competitions (drawing, reading, etc.) or directly provided by teachers: "At my old school, if we studied everything really well, the teacher, who was great, really good, would give us a bag of sweets" (5X_04_06, GD3).

Regulation strategies

A third factor analysis was performed with the 15 items related to regulation strategies, obtaining the solution of three factors presented in Figure 6, which together explain 44.48% of the variance.

Figure 6

Theoretical grouping of regulation items and factors resulting from the CFA.



Note: Grey arrows indicate saturations greater than .300 in absolute value and black arrows of a more intense colour indicate saturations above .500; dotted arrows represent negative saturations.

In this case, the grouping of items almost entirely respected the composition of the original subscales. All self-regulation items saturate the first factor. In the second factor, items related to the absence of regulation are clearly grouped together, with items ER58 and ER46, originally external regulation items, having negative loadings. Therefore, in this case, the absence of regulation is also defined by the lack of consideration given to the tasks and instructions provided by the teachers. In the third factor, external regulation items have high loadings.

With regard to the contributions of the discussion groups, external regulation emerged very strongly, with mention of the fact that, in order to study and make decisions about how to do so, they follow the teachers' instructions exactly. In most cases, it is identified as a supportive element that helps them learn better:

> Help that, for example, he gives us as... In sixth form, he usually gives us one or two whole topics to study. For example, instead of studying the whole topics, you have to take the most important points from the page and make an outline or something like that. (unidentified voice, GD2)

On the other hand, students talk extensively about situations in which they do not understand something and find it difficult to continue with a task or problem. In this case, the experience that seems to be most common in the three discussion groups is the one described below: "I try to do it. But if I see that I've been trying to do it for a while and I see that I can't do it, then I have to wait until I get home." (4X_17_06, GD1).

When trying to explore how they could get help, classmates or teachers were mentioned; however, the fact of asking family members for help continued to emerge. Shame is identified as an element that could constitute an obstacle when asking for clarification, as it is associated with not having completed the assigned tasks .

In terms of self-regulation, students mainly talk about their strategies for planning homework assignments. The diary is a widely used resource, and this planning also has a stress-regulating function, as they state that they sometimes choose to do their homework on the same day it is assigned, regardless of the deadline, so as not to feel overwhelmed by a backlog of tasks. Other planning resources emerge, and in general, all students say that they independently decide on the best time to do their homework, which is in the afternoon at home.

It should be noted that self-regulation of learning content does not generally emerge; however, process regulation does appear in the students' discourse and, once again, is also related to emotional regulation, as it controls the overwhelming feeling of having a lot of material to study: [Facilitator: And what works best of all the things you do?) Many voices: "Outlines." "The thing is, to study the whole topic [...] It's overwhelming, but if you do each thing in a table, it makes it easier." (unidentified voice, GD2)

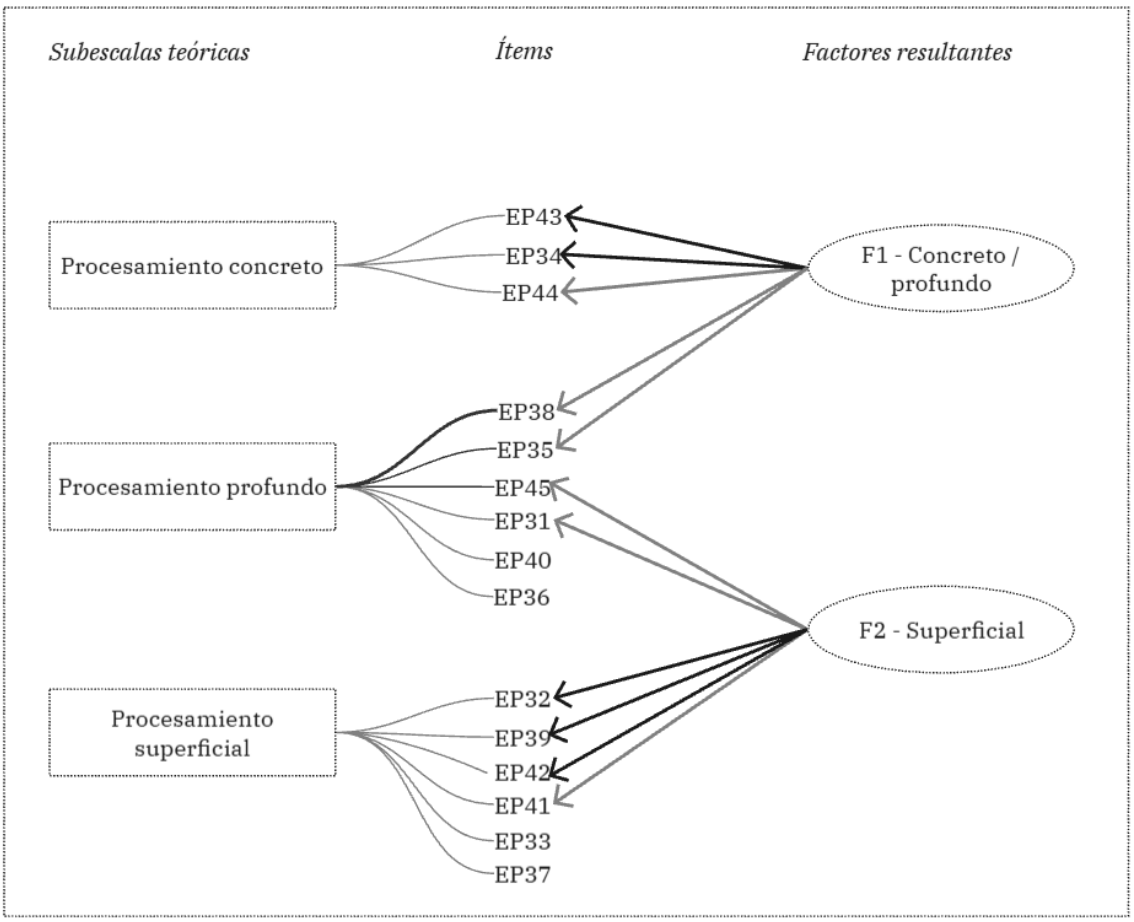
Regarding the absence of regulation, one student describes her feeling of being stuck: "When I don't know how to do that exercise, sometimes I just stare at the book, you know? Just staring." (5X_02_06, GD1)

Processing strategies

In the EFA of the 15 items related to processing strategies, a 2-factor solution was retained, explaining 33.82% of the variance.

Figure 7

Theoretical grouping of processing items and factors resulting from the EFA.



Note: Grey arrows indicate saturations greater than .300 in absolute value, and black arrows of a more intense colour indicate saturations above .500.

As shown in Figure 7, the first factor saturates the concrete processing items with higher weights, followed by elaboration and structuring. Therefore, it is defined as concrete/deep processing, merging the corresponding original subscales.

In the second factor, higher saturations are found in items related to strategies of memorisation and rehearsal, followed by sequential analysis. Therefore, this factor is referred to as surface processing. It is also related to critical processing; thus, it does not necessarily describe unreflective learning, but rather indicates rote and sequential study strategies.

In the discussion groups, students explain their own strategies for working with the study material by establishing relationships between concepts, mainly through the use of underlining, creating outlines, and colour coding different concepts. However, despite the implementation of deep processing strategies, repetition and memorisation of learning content are topics that feature strongly in the discussions. In general, studying is described as repeating what they have already heard in explanations or read, in order to remember it; and study strategies are based on repetition and rehearsal: "... go over it a few times and when I've got it pretty good, we either underline it or close the book and go over it in our heads." (5X_12_06, GD1).

The students themselves recognise that these strategies are sometimes ineffective, as they find it difficult to maintain concentration and interest and need to read the same paragraph many times, sometimes, to even understand it. Even so, repetition is used as a strategy to improve comprehension of a problem to be solved: "... sometimes if I read the statement many times, I might be able to understand it." (5X_02_06, GD1).

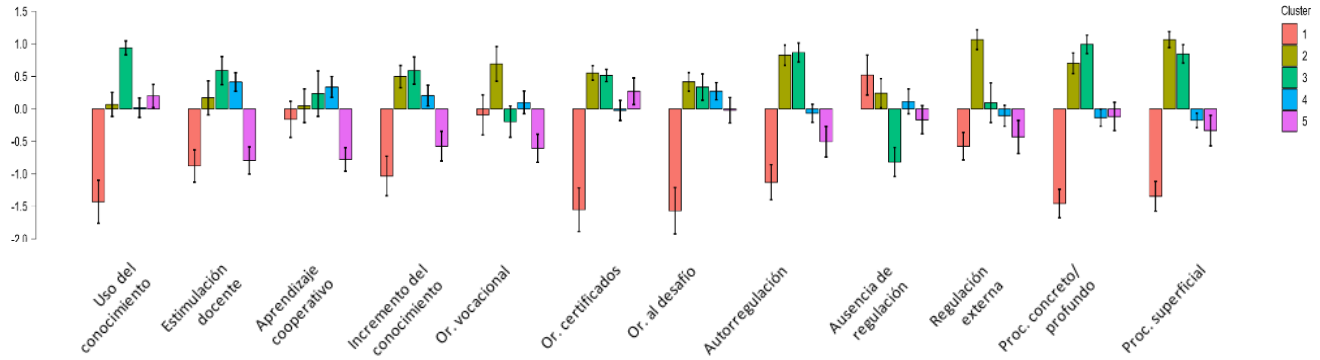
Analysis of learning patterns

To identify the students' LP from the ILS data, a cluster analysis was performed. Prior to this, the reliability and quality indices of the factor scores (reported in the supplementary material) were analysed: overall, and considering the exploratory nature of the study, it was assessed that the EAP estimates could be sufficiently accurate and stable to continue with the analyses.

After testing different solutions, a five-cluster solution was defined (shown in Figure 8) once the evaluation metrics had been assessed and with the criterion of not isolating small clusters.

Figure 8

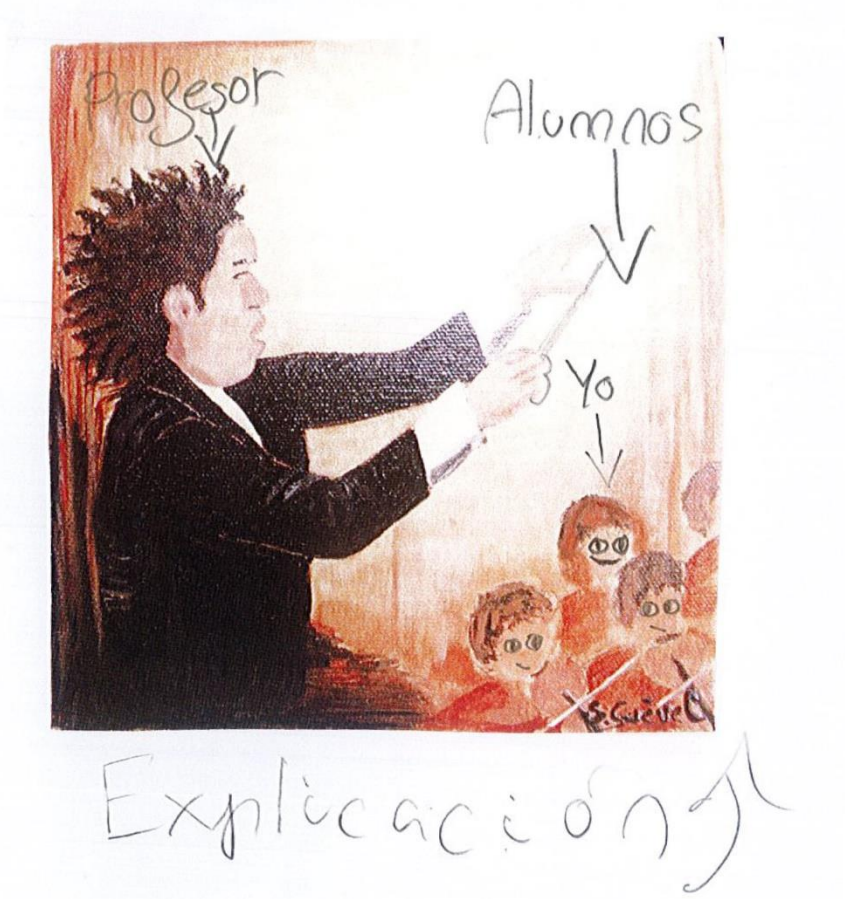
Graph of subscale means, by cluster



In the first cluster (composed of 30 cases, 13.76%), the absence of regulation stands out, while in the other subscales they obtain lower means than the rest of the sample: this would therefore be the cluster that best represents the UD pattern. In the discussion groups, students with a predominantly UD pattern stand out for their contributions about feeling blocked when faced with study material and for images such as the following, where the student is depicted at the end of the class in a passive position with respect to the teacher (as illustrated in Figure 9).

Figure 9

"Teacher" (Sylvie Guével)



Note. Image chosen to represent learning (4X_04_06, GD3)

As for the second cluster, comprising 16.97% of the sample (37 students), there is a prevalence of external regulation and surface processing, with a conception of learning as an increase in knowledge (although this is not the group that stands out most in this subscale); it is the cluster that most closely identifies with the three orientations, particularly the vocational and certificate-oriented ones. For all these reasons, this cluster is associated with the RD pattern, with the characteristic of bringing together people with a strong motivational orientation.

The third cluster comprises 33 cases (15.14% of the sample), which are distinguished by a conception of learning related to the use of knowledge, self-regulation strategies and concrete/deep processing; although they also present a comparatively higher level of surface processing, as well as a conception of learning as an increase. This cluster would represent the MD/AD pattern: with the characteristic of also presenting a conception related to teacher stimulation, with the teacher playing a leading role in motivating students. However, the students participating in the discussion groups with this pattern show a more active role than the previous ones, imagining themselves as protagonists in the learning situation; for example: "Well, I'm explaining something, explaining it to the others" (4X_11_06, GD3).

The fourth cluster consists of 78 cases (35.78% of the sample) and has scores close to the group average on almost all subscales; the elements that emerge most are the concept of teacher stimulation, cooperative learning and challenge orientation. This group of students does not have a clearly defined pattern and shows a certain external dependence for the activation of their learning. In the discussion groups, the great heterogeneity in the contributions of students with this pattern stands out, revealing a diversity of conceptions, motivations, and actions. In some cases, they even describe highly planned learning strategies oriented towards reworking; however, there is a significant presence of other agents, such as family members, who review and supervise these strategies.

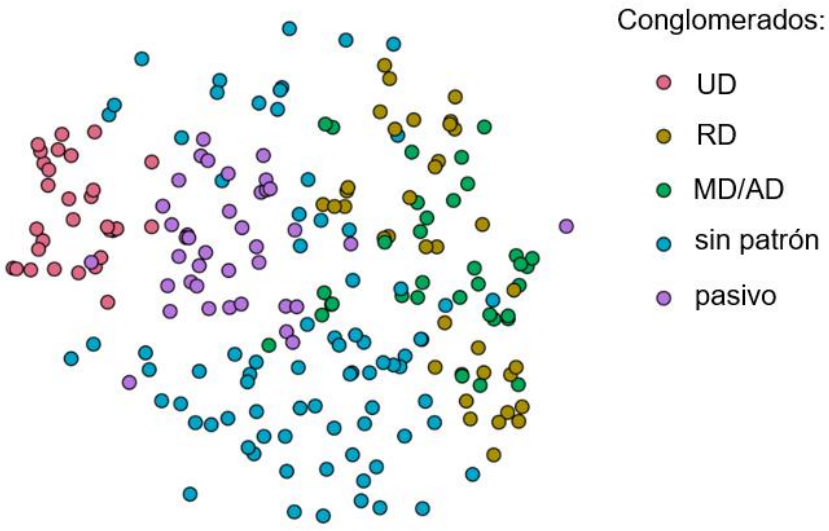
The fifth and final cluster groups 40 cases (18.35% of the sample) with lower than average scores, except for the

orientation towards certificates and the conception of learning as the use of knowledge. Again, this appears to be a poorly defined group in terms of learning processes, although it can be assimilated into a passive pattern. As in the previous case, the diversity in the students' contributions stands out; however, they agree on expressing some difficulties in learning tasks: "This is my brain. And these are all the things I do. And here I am. This little thing here, that's me. [...] And sometimes they get tangled up." (5X_08_06, GD3).

Finally, it should be noted that the silhouette measure was .07, indicating that the grouping is not incorrect, but is weakly defined, as the groups overlap and are not dense. The R2 was .356. Figure 10 confirms that the clusters overlap considerably. Above all, the fourth cluster appears scattered, while the UD pattern appears to be the most compact and clearly differentiated from the others, especially from the RD and MD/AD clusters.

Figure 10

Cluster graph (t-SNE)



Discussion

The study aimed to gather evidence of the validity of the model of learning patterns in primary education based on methodological triangulation. Regarding the first research question, the quantitative data show a structure similar to the original model in the component of regulation strategies: self-regulation, external regulation and absence of regulation were clearly differentiated. However, in the other components, pronounced differences were observed, with another factorial structure emerging.

In terms of conceptions, it appears that the conception of knowledge use was aligned with a conception of learning as a process (understanding, summarising, using), while the increase in knowledge focused on content (definitions, resources, material worked on in class, syllabus). On the other hand, the conception of cooperative learning was limited to the preference or importance given to receiving help and advice from classmates, reflecting the conception originally described by Vermunt (1998) that preference or enjoyment of working in teams, proposed by Hederich-Martínez and Camargo Uribe (2019).

With regard to motivations, items relating to ambivalent orientation, self-assessment and personal interest were merged into a factor called challenge orientation, defined as a motivation to learn aimed at accomplishing a difficult task that demonstrates one's own abilities. This type of orientation is already covered in the literature: for example, Severiens and Ten Dam (1997) found a pattern called "self-test orientation" in secondary education for adults with a history of academic failure.

In terms of processing strategies, the factor structure was simplified, with two types of strategies emerging. On the one hand, concrete/deep processing related to the elaboration and structuring of content, as well as the transfer of learning to other situations and problem solving. On the other hand, surface processing consisting of memorisation and rehearsal items, one item of sequential analysis ( ) and two items of critical processing.

Cluster analysis of ILS scores revealed that the largest group in the sample could not be characterised by a specific pattern, and the grouping in general was not clearly defined. However, a cluster of students with a UD pattern was identified, clearly differentiated from a group of MD/AD students and another RD group. In this version of the UD pattern, cooperative learning did not emerge as a defining factor, generally obtaining low values. On the other hand, the association between the UD pattern and cooperative learning has already been discussed in recent research, such as in the study by Delgado-Orrillo et al. (2023).

These results confirmed the relevance of this pattern structure, even for this stage, considering that the MD/AD pattern has also been observed in other educational settings, including universities (Gaeta González et al., 2020). On the other hand, the evolutionary hypothesis of Vermunt and Verloop (2000) seems to be confirmed: the convergence of the components of beliefs, motivations, and strategies into a coherent pattern is formed as the person grows and advances in their educational journey; it is possible that between the ages of 9 and 12, only the most pronounced differences can be observed.

The second research question was based on specific elements in the students' discourses to contribute to the adaptation of the theoretical model and the ILS to this stage. In this sense, the analysis of the discussion groups allowed for a better understanding of the meaning they give to the constructs of the model and examples that illustrate them. Regarding conceptions of learning, it is clear that the teacher stimulation subscale should be expanded to include other agents who, at this stage, are very relevant to school learning processes: families (Hsieh, 2022; Xia, 2024). Based on the students' contributions, new items could be created that include this facet of the concept, as well as others that complement that of increasing knowledge, in order to improve its accuracy.

On the other hand, in the motivational component, it is appropriate to include challenge orientation, which emerged both in the structure of the ILS and in the dialogues during the discussion groups. In addition, the qualitative analysis revealed that it would be advisable to add another motivational element, such as the obligation on the part of families, teachers or the education system itself; and in the certificate orientation subscale, to incorporate other aspects apart from grades, such as "negative points" or similar reward/punishment systems.

Finally, the qualitative analyses revealed emotional aspects that would be interesting to include in the model to explore how they interrelate with the other components, as already suggested by Ahmedi and Martínez-Fernández (2023). Above all, students referred to process regulation and processing strategies as a way of controlling stress and feelings of overwhelm, but emotions also emerged among conceptions of learning (fun, boredom, fear of reprimands, etc.).

Conclusions

In conclusion, this research provides elements for discussing the theoretical model of learning patterns in primary education, confirming its usefulness for understanding the conceptions, orientations, strategies, regulation, and processing of these students, and for identifying the combination of these elements, which is not yet fully crystallised.

This study has some limitations. Its exploratory nature requires further analysis in different samples to confirm the factorial structure found. Likewise, the small number of participants in the qualitative subsample limits the scope of the results and has made triangulation with quantitative data particularly difficult. However, this initial approach is presented as a way to deepen and refine future studies, in which a revised version of *the Inventory of Learning Patterns of Students* could be used based on the emerging factorial structure. In addition, some literal quotes from the students may contribute to the reformulation of some items, using their language and some examples, and to the creation of new subscales, based on the topics of interest that the students seem to link to their conceptions about learning, their motivational orientation, and their regulation and processing strategies. In this way, we will have a specific theoretical and methodological model for understanding and supporting learning processes during the primary education stage.

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Supplementary material

Table A1

Rotated factor loadings matrix (conceptions of learning)

Item	F1	F2	F3	F4
CA7: *For me, learning means having knowledge that I can use outside of school.*	.773	-.102	.118	-.237
CA15: *For me, learning is having information that I can use immediately or in the future.*	.654	-.095	.008	.176
CA2: *The things I learn should help me solve problems that may arise in my daily life.*	.424	.300	-.018	-.005
CA11: *In order to know if I have understood a topic well, I think I should summarise it in my own words.*	.437	.079	-.183	-.049
CA1: *For me, learning means trying to understand a problem in different ways.*	.332	.268	-.099	.087
CA13: *In order to learn, the teacher must motivate and encourage me.*	.007	.672	.044	.093
CA10: *The teacher should encourage me when I study and tell me how I should study.*	-.093	.637	.066	.178
CA5: *When I don't understand something, I think the teacher should encourage me to find a solution.*	.118	.524	.073	.116
CA9: *In order to learn, I believe it is important for my classmates to give me advice.*	-.088	.128	.942	.025
CA4: *In order to learn, if I have any questions about a topic, I prefer to ask my classmates for help.*	.101	-.173	.513	-.005
CA8: *In order to learn, I should memorise definitions and other facts on my own.*	.074	-.046	-.104	.634
CA6: *In order to learn, I should consult other books or resources (websites) on my own.*	.048	(-.418)	.187	.491
CA3: *For me, learning means being able to repeat what we have done in class.*	.176	.058	-.072	.498
CA12: *For me, learning means repeating the syllabus until I know it well.*	-.082	-.011	.007	.518
CA14: *To learn, I prefer to prepare for an exam together with other classmates.*	.180	.243	.151	-.129
Explained variance	23.46%	12.12%	10.35	8.49
α	.579	.666	.504	.500
ORION	.756	.778	.994	.697
FDI	.870	.882	.997	.835
H-Latent	.756	.778	.994	.697

Note. Fit indices: RMSEA =.038; χ^2 (51) = 67.147 p = .06; NNFI = .964; CFI = .983; RMRS = .0537.

Table A2

Rotated factor loadings matrix (learning orientations)

Item	F1	F2	F3
OM30: *What I learn at school prepares me for future work.*	.953	-.185	-.095
OM18: *School prepares me for what I want to be when I grow up.*	.790	-.050	.066
OM21: *When I learn, I know what I am capable of doing and what I am not.*	.406	.028	.070
OM27: *I want to learn subjects that will prepare me for a profession.*	.376	.137	-.042
OM23: *I study only to pass exams.*	.045	.764	(-.430)
OM28: *For me, the most important thing is to pass the exams.*	-.199	.770	-.134
OM26: *I try harder in the subjects I like.*	.283	(.442)	-.527
OM20: *I study to get the best grades in the class.*	-.012	.470	(.395)
OM25: *I want to prove to myself that I am capable of passing this course.*	.093	.123	.692
OM29: *I like learning subjects at school, even if they are difficult for me.*	-.009	.086	.679
OM17: *I want to prove to my family and teachers that I am capable of passing this course.*	.189	.090	.539
OM16: *I am interested in learning new things.*	.172	-.056	.570
OM19: *I am confident in my ability to study.*	.021	.060	.458
OM22: *I believe it is worthwhile to work hard at my studies.*	-.072	.006	.408
OM24: *I doubt that what I learn at school will be useful for my future.*	-.103	.284	-0.029
Explained variance	28.11	14.85%	8.81
α	.596	.578	.561
ORION	.873	.791	.840
FDI	.934	.890	.917
H-Latent	.873	.791	.840

Note. Fit indices: RSMEA = .029; χ^2 (63) = 74.802 p = .14; NNFI = .985; CFI = .991; RMSR = .067.

Table A3

Rotated factor loadings matrix (regulation strategies)

Item	F1	F2	F3
ER48: *When I start reading a new topic, I first think about the best way to learn it.*	.590	-.101	.054
ER52: *When I find something difficult to learn, I ask myself why it is difficult for me.*	.535	(-0.346)	-.130
ER56: *I always study what is required and add more information.*	.508	-.155	.055
ER50: *If I don't fully understand what I'm studying, I try to find another text that helps me understand it.*	.463	-.120	-.080
ER47: *In addition to the material I am given at school, I consult other books or the Internet for the subject matter I am studying.*	.434	-.026	.194
ER55: *To find out if I have learnt something, I try to ask myself questions or explain it in my own words.*	.400	.031	-.111
ER54: *I find it difficult to understand the teacher's instructions.*	.046	.600	-.053
ER59: *I forget to ask for help when I have difficulties studying.*	.120	.488	.129
ER49: *When there is a lot of information to learn, I find it difficult to study.*	-.183	.472	.061
ER51: *To do the work, I only take into account the instructions given to me by the teacher.*	-.222	.076	.735
ER53: *I assess my learning only with the exercises in the book or those given to me by the teacher.*	.076	-.007	.546
ER57: *I learn everything exactly as it appears in the textbooks.*	.212	.039	.484
ER58: *I believe that the homework assigned by my teacher is necessary for learning.*	-.040	(-.398)	.424
ER46: *I study all subjects following the instructions given to me by the teacher*.	(.266)	(-.385)	.412
ER60: *If I am able to complete all the tasks given to me by the teacher, I believe I have mastered the subject.*	.113	-.059	.303
Explained variance	21.2	12.6%	10.7
α	.572	.413	.578
ORION	.727	.656	.732
FDI	.853	.810	.856
H-Latent	.727	.656	.732

Note. Fit indices: RSMEA = .015; χ^2 (63) = 65.962 p = .37; NNFI = .993; CFI = .996; RMSR = .058.

Table A4

Rotated factor loadings matrix (processing strategies)

Item	F1	F2
EP43: *I use what I learn in my daily life.*	.832	-.177
EP34: *I use what I learn at school in other situations.*	.640	-.017
EP38: *I try to get a general idea of everything I have studied in a subject.*	.476	.098
EP44: *I like subjects that help me solve practical problems.*	.464	.151
EP35: *I relate the new topic of a subject to what I already knew.*	.430	-.036
EP32: *I memorise the meaning of every word I don't know.*	-.036	.655
EP39: *I repeat the most important parts of a subject until I know them by heart.*	-.051	.545
EP42: *I memorise definitions as they appear in the book and as the teacher tells me.*	-.179	.595
EP41: *Until I have mastered one topic perfectly, I do not move on to the next one.*	.039	.467
EP45: *I reflect on what I study.*	.180	.430
EP31: *I draw my own conclusions from what I study.*	.069	.391
EP40: *I try to understand the relationship and differences between subjects.*	.207	.299
EP36: *I compare my point of view (my ideas) with that of other people.*	.093	-.042
EP33: *When I study, I focus on the details.*	.108	.124
EP37: *I study each part of the syllabus separately.*	-.047	.287
Explained variance	24.52	9.30
α	.605	.587
ORION	.779	.751
FDI	.883	.867
H-Latent	.779	.751

Note. Fit indices: RSMEA = .015; χ^2 (63) = 79.591 p = .37; NNFI = .994; CFI = .996; RMSR = .067.

In all tables, factor loadings below .300 in absolute value are indicated in grey; and in parentheses, loadings greater than or equal to .300 for items that show higher saturation in another factor.