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Generalización de la fiabilidad del inventario de patrones de aprendizaje de estudiantes en Educación Superior: Consistencia según territorios, edades y versiones

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تعميم موثوقية قائمة أنماط التعلم لدى طلاب التعليم العالي: الاتساق حسب المناطق والأعمار والإصدارات

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Abstract

The theoretical model of learning patterns and the Inventory of Learning patterns of Students (ILS) have had a relevant impact, prompting international research on students' learning in different territories. Using a meta-analysis design, this study aims at summarizing the available evidence in Web of Science, Scopus, PsycINFO, ERIC and Google Scholar, regarding the reliability of the ILS scores in Higher Education (HE) students. The analyses focused on synthesizing alpha coefficients through random-effects models and analyzing the influence of moderating variables with weighted regression and meta-ANOVA. Inclusion criteria were different type of primary studies using students of HE and upper, non-compulsory secondary education. Literature or empirical reviews, qualitative studies were excluded. Results of 46 applications of the ILS were included, which provided 698 alpha coefficients. The combined reliability coefficients ranged from $\alpha=.55$ ("personal interest") to $\alpha=.83$ ("deep processing"). Moderation analyses revealed that age of the participants, territory and ILS version affected to a greater extent the reliability of learning conceptions and orientation, rather than processing and regulation strategies. Findings support the use of ILS in different territories, indicate some areas of improvement for specific subscales and contexts of application, and highlight the possibility of adapting it to other contexts. The relevance of identifying the components analyzed by the ILS for their usefulness in improving learning and teaching strategies in HE is discussed. Nonetheless, incomplete reporting of key study details -like sample traits, age ranges, version differences, and translation practices- reduces the accuracy and clarity of moderation analyses.

Keywords: learning processes, reliability, Higher Education, self-regulation

Resumen

El modelo teórico de patrones de aprendizaje y el Inventario de Patrones de Aprendizaje de Estudiantes (ILS) han tenido un impacto relevante, impulsando investigación internacional en diferentes territorios. Este estudio metanalítico tiene como objetivo resumir la evidencia disponible en Web of Science, Scopus, PsycINFO, ERIC y Google Scholar, sobre la fiabilidad de las puntuaciones del ILS en estudiantes de Educación Superior (ES). Se sintetizaron coeficientes alfa a través de modelos de efectos aleatorios y se analizó la influencia de las variables moderadoras con regresión ponderada y meta-ANOVA. Se incluyeron diferentes tipos de estudios primarios con estudiantes de ES y educación secundaria superior, excluyendo revisiones y estudios cualitativos. Los resultados de 46 aplicaciones del ILS proporcionaron 698 coeficientes alfa. Los coeficientes de fiabilidad combinados variaron de $\alpha=.55$ ("interés personal") a $\alpha=.83$ ("procesamiento profundo"). Los análisis de moderación revelaron que la edad de los participantes, el territorio y la versión del ILS afectaron a la fiabilidad de las concepciones y la orientación del aprendizaje, más que de las estrategias de procesamiento y regulación. Los hallazgos respaldan el uso del ILS en diferentes territorios, indican algunas áreas de mejora para subescalas y contextos de aplicación específicos, y destacan la posibilidad de adaptarlo a otros contextos. Se discute la relevancia de identificar los componentes analizados por el ILS por su utilidad en la mejora de las estrategias de aprendizaje y enseñanza. No obstante, el informe incompleto de detalles clave del reduce la precisión y la claridad de los análisis de moderación.

Palabras clave: procesos de aprendizaje, fiabilidad, Educación Superior, autorregulación

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Resumo

O modelo teórico de padrões de aprendizagem e o Inventário de Padrões de Aprendizagem de Estudantes (ILS) tiveram um impacto relevante, impulsionando a investigação internacional em diferentes territórios. Este estudo meta-analítico tem como objetivo resumir as provas disponíveis na Web of Science, Scopus, PsycINFO, ERIC e Google Scholar sobre a fiabilidade das pontuações do ILS em estudantes do Ensino Superior (ES). Os coeficientes alfa foram sintetizados através de modelos de efeitos aleatórios e a influência das variáveis moderadoras foi analisada com regressão ponderada e meta-ANOVA. Foram incluídos diferentes tipos de estudos primários com estudantes do ES e do ensino secundário, excluindo revisões e estudos qualitativos. Os resultados de 46 aplicações do ILS forneceram 698 coeficientes alfa. Os coeficientes de fiabilidade combinados variaram entre $\alpha=.55$ (“interesse pessoal”) e $\alpha=.83$ (“processamento profundo”). As análises de moderação revelaram que a idade dos participantes, o território e a versão do ILS afetaram a fiabilidade das conceções e da orientação da aprendizagem, mais do que das estratégias de processamento e regulação. Os resultados apoiam a utilização do ILS em diferentes territórios, indicam algumas áreas de melhoria para subescalas e contextos de aplicação específicos, e salientam a possibilidade de o adaptar a outros contextos. Discute-se a relevância de identificar os componentes analisados pelo ILS quanto à sua utilidade na melhoria das estratégias de aprendizagem e ensino. No entanto, o relatório incompleto de detalhes essenciais reduz a precisão e a clareza das análises de moderação.

Palavras-chave: Processos de aprendizagem, fiabilidade, Ensino Superior, autorregulação.

摘要

学习模式理论模型及学生学习模式量表 (ILS) 在国际教育研究领域产生了广泛影响, 并在不同地区得到应用。本项元分析研究旨在综合 Web of Science、Scopus、PsycINFO、ERIC 与 Google Scholar 数据库中关于 ILS 在高等教育学生中信度的实证证据。研究采用随机效应模型整合 Cronbach α 系数, 并通过加权回归与元方差分析 (meta-ANOVA) 考察调节变量的影响。研究纳入了针对高等教育及高中后教育学生的多种初级研究类型, 排除综述性与质性研究。共分析了 46 次 ILS 应用, 获得 698 个 α 系数, 其综合信度系数范围介于 $\alpha=0.55$ (“个人兴趣”) 至 $\alpha=0.83$ (“深层加工”) 之间。调节分析结果显示, 参与者年龄、研究地区及 ILS 版本对学习观念与学习取向维度的信度影响大于对加工策略与调节策略维度的影响。研究结果支持 ILS 在不同地区的应用, 同时指出某些分量表及特定应用情境中仍有改进空间, 并强调其向其他教育情境适配的潜力。文章进一步讨论了 ILS 所测量构成要素在改进学习与教学策略中的实际价值。然而, 部分研究对关键信息报告不完整, 降低了调节分析的精确性与解释力。

关键词: 学习过程; 信度; 高等教育; 自我调节。

ملخص

تأثير كبير، حيث حفز البحث الدولي في مختلف المجالات. تهدف هذه (ILS) كان للنموذج النظري لأنماط التعلم ومخزون أنماط التعلم لدى الطلاب حول موثوقية Google Scholar و ERIC و PsycINFO و Scopus و Web of Science الدراسة التحليلية إلى تلخيص الأدلة المتاحة في تم توليف معاملات ألفا من خلال نماذج التأثيرات العشوائية وتم تحليل تأثير المتغيرات المعتدلة (ES) لدى طلاب التعليم العالي ILS درجات تم تضمين أنواع مختلفة من الدراسات الأولية مع طلاب التعليم العالي والتعليم الثانوي العالي، ANOVA باستخدام الانحدار المرجح والمتوسط (”الاهتمام $\alpha=.55$ معامل ألفا. تراوحت معاملات الموثوقية المجمع من 698 ILS باستثناء المراجعات والدراسات النوعية. قدمت نتائج 46 تطبيقاً لـ أثرت على موثوقية المفاهيم ILS (”المعالجة العميقة”). كشفت تحليلات التوسط أن عمر المشاركين والمنطقة وإصدار $\alpha=.83$ الشخصي”) إلى في مناطق مختلفة، وتشير إلى بعض المجالات التي يمكن تحسينها ILS وتوجه التعلم، أكثر من استراتيجيات المعالجة والتنظيم. تدعم النتائج استخدام بالنسبة للمقاييس الفرعية وسياقات التطبيق المحددة، وتسلب الضوء على إمكانية تكيفه مع سياقات أخرى. تتم مناقشة أهمية تحديد المكونات التي يحلها في مناطق مختلفة، وتشير إلى بعض المجالات التي يمكن تحسينها في المقاييس الفرعية وسياقات ILS من أجل استخدامه. تدعم النتائج استخدام ILS لفائدتها في تحسين ILS التطبيق المحددة، وتسلب الضوء على إمكانية تكيفها مع سياقات أخرى. تتم مناقشة أهمية تحديد المكونات التي يحلها استراتيجيات التعلم والتدريس. ومع ذلك، فإن عدم اكتمال التقرير عن التفاصيل الرئيسية يقلل من دقة ووضوح تحليلات الاعتدال

العنف ضد المرأة في العلاقات: عمليات التعلم، الموثوقية، التعليم العالي، التنظيم الذاتي

Introduction

The analysis of the approach to learning in university students is an area of research that connects beliefs and actions in learning processes; this field of research, in the intersection between Student Approaches to Learning (SAL) tradition on one hand, and Self-Regulated Learning (SRL) on the other hand, investigates the activation of the learner (learning strategies) based on their belief about learning (conceptions and orientations). In this study, we discuss the reliability of an instrument in the analysis of the approach to learning: namely, the Inventory of Learning patterns of Students developed by Vermunt (1996). This tool has been applied in a useful and interesting way in various territories (Shum et al., 2024; Vermunt, 2020); nevertheless, some authors have highlighted that it should be improved or perhaps complemented with other measures that will allow to have clearer evidence of the approach to learning of university students (Hederich & Camargo, 2019). An increasingly promising issue is the identification of the learning pattern, as it will allow us to work more accurately on the design of personalized learning pathways. This is undoubtedly a matter of interest to policy makers, curriculum designers and teacher trainers. Thus, identifying learning patterns (and their components) based on a deep, differentiated and reliable understanding is essential for designing interventions aimed at improving learning and teaching processes.

Therefore, it is considered tremendously important to discuss the reliability of the core instrument in the light of information obtained in various studies around the world; as a relevant step to revise the adjustment of the tool and the stability of its scores across different territories, language and cultural adaptations, and settings. In this sense, the aim is to contribute to the revision of a theoretical model and its instrument, which is widely used, but which requires adjustment according to the territory or area of application.

Learning patterns

A learning pattern is defined as a “coherent whole of learning activities that learners usually employ, based on their beliefs about learning and their learning motivation, a whole that is characteristic of them in a certain period of time.” (Vermunt & Donche, 2017, p. 270). Thus, a component of beliefs (conceptions of learning and learning orientations) and a component of actions (regulation- and processing strategies) to learn. In Table 1, the subscales are shown, divided by the two components and four subcomponents of the model: conceptions of learning, learning orientations, regulation strategies and processing strategies.

The original inventory was composed of 120 Likert items answered on a scale from 1 to 5 and distributed across 16 main subscales. Vermunt (1998) proposed a different number of items depending on the subscale to be assessed. Belief items are answered from strongly disagree (1) to strongly agree (5) with each of the beliefs expressed. Action items (regulation- and processing strategies) are answered from never (1) to always (5) depending on the frequency with which these activities are carried out. Some subscales, such as “deep processing” (11 items), can be split into two smaller subscales: “relating and structuring” (7 items) and “critical processing” (4 items). This way, two item structures can be used: one with the 16 main subscales, and another with all 20 individual subscales.

After this original version, some versions were adapted, either to specific populations (e.g., for secondary and primary education, as the ILS-60-item version by Martínez-Fernández et al., 2015) or to reduce application time (such as Vermetten et al., 1999, who proposed a 100-item version). In the reduced 60-item version, the items are equally distributed among the 20 subscales; thus, 3 items for each subscale were selected, considering previous results on factor analyses and items’ understandability across different populations and contexts (Martínez-Fernández & Vermunt, 2015).

Table 1. Subscales of the ILS

Subscale of the ILS	N. items	Description of content
Processing strategies		
Deep processing	(11)	(Main subscale, encompassing relating and structuring, and critical processing)
<i>Relating and structuring</i>	7	Relating elements of the subject matter to each other and to prior knowledge; structuring these elements into a whole
<i>Critical processing</i>	4	Forming one's own view on the subjects that are dealt with, drawing one's own conclusions, and being critical of the conclusions drawn by textbook authors and teachers
Stepwise processing	(11)	(Main subscale, encompassing memorizing and rehearsing, and analysing)
<i>Memorizing and rehearsing</i>	5	Learning facts, definitions, lists of characteristics, and the like by heart by rehearsing them
<i>Analyzing</i>	6	Going through the subject matter in a stepwise fashion and studying the separate elements thoroughly, in detail and one by one
Concrete processing	5	Concretizing and applying subject matter by connecting it to one's own experiences and by using in practice what one learns in a course
Regulation strategies		
Self-regulation	(11)	(Main subscale, encompassing learning process and results, and learning content)
<i>Learning process and results</i>	7	Regulating one's own learning processes through regulation activities like planning learning activities, monitoring progress, diagnosing problems, testing one's outcomes, adjusting, and reflecting
<i>Learning content</i>	4	Consulting literature and sources outside the syllabus
External regulation	(11)	(Main subscale, encompassing learning process and learning results)
<i>Learning process</i>	6	Letting one's own learning processes be regulated by external sources, such as introductions, learning objectives, directions, questions, or assignments of teachers or textbook authors
<i>Learning results</i>	5	Letting one's own results indicate whether one is learning adequately, evaluating performance based on the outcomes obtained.
Lack of regulation	6	Monitoring difficulties with the regulation of one's own learning processes

Note: adapted from Vermunt and Donche (2017). In parentheses, the total number of items of the main subscales are indicated. In italics, the smaller subscales (that can be groups into the main subscales) are indicated.

Table 1. Subscales of the ILS (*continued*)

Subscale of the ILS	N. items	Description of content
Conceptions of learning		
Construction of knowledge	9	Learning as constructing one's own knowledge and insights. Most learning activities are seen as tasks of students.
Intake of knowledge	9	Learning as taking in knowledge provided by education through memorizing and reproducing; other learning activities are tasks of teachers.
Use of knowledge	6	Learning as acquiring knowledge that can be used by means of concretizing and applying. These activities are seen as tasks of both students and teachers.
Stimulating education	8	Learning activities are viewed as tasks of students, but teachers and textbook authors should continuously stimulate students to use these activities.
Cooperative learning	8	Attaching a lot of value to learning in cooperation with fellow students and sharing the tasks of learning with them
Learning orientations		
Personally interested	5	Studying out of interest in the course subjects and to develop oneself as a person.
Certificate oriented	5	Striving for high study achievements; studying to pass examinations and to obtain certificates, credit points, and a degree.
Self-test oriented	5	Studying to test one's own capabilities and to prove to oneself and others that one can cope with the demands of higher education
Vocation oriented	5	Studying to acquire professional skill and to obtain a(nother) job.
Ambivalent	5	A doubtful, uncertain attitude toward the studies, one's own capabilities, the chosen subject area, the type of education, etc.

Note: adapted from Vermunt and Donche (2017). In parentheses, the total number of items of the main subscales are indicated. In italics, the smaller subscales (that can be groups into the main subscales) are indicated.

The most typical way to analyze data from this instrument has been to calculate the internal consistency of each subscale. Afterwards, a mean score for each subscale is obtained; and these mean scores are introduced in a factor analysis, principal component analysis, and/or in a cluster analysis to obtain the factors that correspond to the learning patterns (Vermunt et al., 2014b). In this regard, international research in this area has

confirmed the originally patterns proposed (Vermunt, 1998): the meaning-directed (MD) pattern, the application-directed (AD), the reproduction-directed (RD), and the undirected (UD) pattern according to several specific combinations of subscale scores. The initially proposed four patterns have been identified in different samples of university students, mainly in European countries. However, in other territories or educational settings,

different structures arose such as the passive-idealistic, flexible, the passive-motivational patterns, and different combinations have been described (Ahmedi, 2022; García-Ravidá, 2017; Marambe et al., 2012; Martínez-Fernández & García-Ravidá, 2012; Martínez-Fernández, et al., 2025; Shum et al., 2024; Vega-Martínez, 2022; Vermunt & Donche, 2017). Moreover, besides the possibility of identifying qualitatively different groups of students in terms of their current learning pattern, this model also allows to consider “how students learn” on a spectrum: everyone can manifest different scores for all the learning patterns, being the combinations dissonant (Vermunt & Minnaert, 2003).

Beyond the research purposes and transferring this tool into the educational practice, the identification of learning patterns of students can be beneficial for teachers to better understand their groups and the different profiles among students, in terms of the configuration of conceptions of learning, motivations and strategies; and to better adjust the instructional strategies and the design of the lesson plans (Martínez-Fernández et al., 2024), or the institutional policies and learning environment (Delgado-Orrillo et al., 2023). Moreover, the ILS can also constitute a tool to acquire metacognitive awareness; since it can facilitate knowledge of one’s learning process, also in the relationship with other classmates with similar and different ways to approach learning activities (Ruiz-Bueno & García-Orrillos, 2019). All these actions are aimed at help students develop more functional processes, to achieve self-regulated and meaningful learning in their disciplines. However, to use this tool, it is necessary to assure that its scores are reliable.

There have been some reviews focused on the analysis of factor structure and measures of central tendency (Vermunt & Donche, 2017; Vermunt & Vermetten, 2004); as well as theoretical discussions that suggest the need to review the validity and reliability aspects of the ILS (Hederich & Camargo, 2019; Martínez-Fernández, 2019). However, the different subscales are constructed based on reliability

analysis, but to date we are not aware of any studies that comprehensively delve into the reliability indicators of such subscales, and consequently of the configurations (patterns) derived from them.

As Martínez-Fernández (2019) argues, there is much room for the international research to grow, investigating the learning patterns based on the ILS and with an inclusive, transcultural perspective. Thus, it becomes evident the need to inquire into the internal consistency of the building bricks for the model of learning patterns, as well as in possible fluctuations of the reliability considering personal and contextual variables. Accordingly, this research focuses on the reliability of ILS subscales, based on the data reported by various studies distributed over a wide territory from America, Europe, Asia and Oceania. All of this is done with the aim of exploring the personal and contextual differences that may affect the measure and, therefore, the pedagogical guidelines derived from it.

Reliability and reliability generalization

Reliability, in its most general meaning, refers to the precision of the measurement obtained by a test (Slaney, 2017). Despite a misconception of reliability of scores as a static property, it can vary from one application to another, depending on the sample, its characteristics, profile or context, or the conditions of application: for example, when an instrument is translated and adapted to other languages (López Pina et al., 2012).

One method to investigate how the reliability of an instrument's scores varies can be the meta-analysis. In this sense, Vacha-Haase (1998) proposed the reliability generalization approach as a type of meta-analysis aimed at examining the error variance obtained by instruments through its applications. In other words, it is a meta-analytic study that investigates how reliability varies in different samples, and which characteristics of the studies or samples can explain this variability (López-Ibáñez et al., 2024).

In the present study, coefficient alpha was used as a measure of reliability, as it is the most reported in empirical studies of the ILS. Under this coefficient, reliability is conceptualized as the internal consistency of the test: that is, the degree to which the parts of the scale are correlated. The alpha represents, concretely, the mean of all possible split-half reliabilities (Cronbach, 1951) when measures are essentially tau-equivalent, with independent errors, and the scale is unidimensional. Despite the lively debate about misuses of alpha coefficient, its problems and alternative options to it (Cronbach & Shavelson, 2004; McNeish, 2018), it remains the most widely reported consistence coefficient, serving practical utilities and representing a lower-bound estimation (Doval et al., 2023). Specifically, in the case of ILS, it is generally used as justification for using mean scores of each subscale, to sub-sequentially build the learning patterns with these mean scores as variables for the factor or clustering analysis.

Regarding the personal and contextual factors that may affect this reliability, in this study we considered a series of substantive aspects of the populations such as: age, territory and specific domain, which were identified in previous research as variables that could affect the understanding of the subscale and the learning pattern in general (Martínez-Fernández & García-Ravidá, 2012; Martínez-Fernández, et al., 2019; Vermunt & Donche, 2017). In this regard, the importance of the components defined by the model is recognized; however, it is also necessary to examine the different configurations in greater depth to personalize the learning and teaching processes.

Among the methodological aspects of the studies that can affect the consistency of measures, we considered the ILS version (120, 100, 60 items) and language. Finally,

publication status and the year of data gathering were considered as extrinsic aspects.

Based on the above, the following questions were proposed:

- Are ILS subscales' scores reliable across different applications?
- How can the variability among reliability coefficients be explained based on substantive, methodological and extrinsic factors?
- How can researchers improve the reliability of the subscales?

The answers to these questions can help develop researchers and practitioners some guidelines to use this instrument and further develop it. The discussion section of this paper will provide some of these guidelines.

Method

To answer the research questions, a reliability generalization study was proposed to meta-analytically integrate the reliability coefficients obtained in ILS applications in different samples, cultures and contexts. As guidelines, Prisma Statement (Page et al., 2021) was used; primary authors reviewed Prisma 2020 expanded checklist before starting the study and ensure that all authors complied with all items during the writing process. The first author finally assessed the manuscript and verified compliance to 80% of elements in the checklist. Some of the criteria were not fully met because of extension limitations of the manuscript; however, detailed outputs and additional results were published via open materials (Ciraso-Calí et al., 2025). The review was pre-registered (Ciraso-Calí et al., 2024), and final database is also available (Ciraso-Calí et al., 2023).

Identification of studies and search criteria

The studies were identified by means of a systematic search of five databases: Web of Science, Scopus, PsycINFO, ERIC and Google Scholar. No language restriction was applied, and the time criterion chosen was "from 1998, inclusive" (since the publication date of Vermunt's seminal article, where the ILS in its 120-item version was first presented to the international academic audience). According to each database, different combinations and adaptations of the following search string was

used: TITLE-ABS-KEY (("Inventory of Learning Patterns" OR "ILP" OR "Inventory of Learning Styles" OR "ILS" OR "learning patterns") AND ("Higher Education" OR "Secondary Education")) AND ALL ("Vermunt").

The second search strategy was to examine the references reported by the primary studies that were being compiled, as well as those included in other systematic reviews on the same topic. Thirdly, the search for grey literature was considered relevant: studies that were not published (in some cases, not yet) in peer-reviewed academic journals. This decision was supported by Conn et al. (2003), who showed that it is not the methodological rigor that varies, in principle, between published literature and grey literature; rather, the latter usually present results that are not statistically significant and have lower effect sizes. Therefore, to investigate publication bias and have a more complete view of the reliability of the ILS, it was considered particularly interesting to use this type of literature, including studies with smaller samples and/or worse psychometric results. However, it was taken into consideration that these reports might lack peer review. In this case, to guarantee a certain methodological quality, it was established that the included unpublished reports had to be written by: (a) authors with articles published in academic journals; or (b) authors who have received advice or supervision from researchers with published articles. Grey literature was obtained from a first search in the professional social networks Academia and ResearchGate; and authors already included in the meta-analytic database were contacted to identify ongoing or unpublished studies, including doctoral theses.

No automation tool was integrated within the study selection process.

Inclusion criteria and data extraction

According to the search criteria, the reviewers' team included as possible primary sources academic articles, published conference proceedings, unpublished research reports, dissertations and doctoral thesis that

were performed or supervised by authors of articles published in academic journals, reporting the use of the same instrument.

The first stage of screening was performed by the first author of the meta-analysis, with the support of another author in case of doubts. In this stage, only titles and abstracts were checked over. Duplicate records were discarded, and it was verified that the studies effectively used the ILS questionnaire, in the original form of Vermunt (1998) or adaptations.

In the second screening phase, two team members were involved, who also consulted others and/or the authors of the primary study, in case of doubt. In this stage, compliance with the selection criteria of the primary sources was verified:

- Participants: samples of students of higher education (including specialized courses such as health sector residency) and upper, non-compulsory secondary education.
- Exposure: through ILS, students are asked to think about their studies and how they perceive their own learning, by responding to a list of statements on learning strategies, motives and attitudes. The exposure is, therefore, to any organized learning experience.
- Control group: not applicable for the purpose of this meta-analysis. If more than one group was involved in a primary study, all responses would be retrieved for this meta-analysis, if the other criteria are met.
- Outcomes: the main outcomes included were the reliability coefficients of the ILS subscales. No conversion was needed, since coefficient alpha was the chosen reliability indicator in all the primary studies. In case of longitudinal data, only the first alpha coefficient was retrieved.
- Study design: cross-sectional, longitudinal, experimental or quasi-experimental were retained. Literature or empirical reviews, qualitative studies were excluded.

After the preliminary search stage, the reviewers' teams set further eligibility criteria: a) Primary studies should use one of the standard versions of ILS (120, 60 or 100 items-versions); and b) The items should be grouped in one of the standard ways (into 16, 20 or 24 subscales); however, it is possible to include studies that do not use some of the subscales,

In case of missing or unclear data, authors of the primary studies were contacted via institutional email or professional social networks. If they did not provide critical information (reliability coefficients, number of items, sample size), the studies would not be included. Likewise, to select data from multiple reports corresponding to only one study, authors were contacted to resolve inconsistencies.

During these screening phases, the reasons why a study was not included was recorded in a shared spreadsheet. The first author of the meta-analysis checked these decisions. In case of disagreement, they were resolved through discussion; in few cases, the involvement of other members of the review was necessary as well. However, after setting the last two eligibility criteria, no disagreement happened.

Finally, 39 reports were included in the review (see Figure 1). These sources informed about 46 independent applications of the ILS and provided a total of 698 alpha coefficients. Total sample was 19.376 participants; however, not every study used all subscales: therefore, in the separate meta-analyses the samples vary from 10.733 ($k = 24$) for "relating & structuring" to 16.972 ($k = 42$) for "lack of regulation".

Out of the 39 reports, 9 of them were grey literature, which contributed 14.03% of the total participants.

Codification

Two reviewers collected data from primary studies. At the beginning, they worked together on five reports, to achieve consensus; after having independently coded the same 10 reports, Cohen's kappa and intraclass correlation coefficients were calculated.

As for the nominal variables, all Cohen's kappa coefficients were 1 except from specific domain, which resulted in .571 ($p = .065$). In this case, three misunderstandings were found in the codification of this variable; these were discussed until total agreement was reached; and each reviewer verified that the codification was correct for the rest of the studies. As for the metric variables, intraclass correlation (mixed effect model with absolute agreement) was computed. All coefficients were above .990 except for the subscales relating & structuring (.665), construction of knowledge (.967) and percentage of boys/girls (.124). These three low coefficients were due to three mistakes in codification, which were corrected. The two reviewers kept regular meetings to share their doubts and to check for multiple reports corresponding to the same study. In these cases, codification was carried out jointly, resolving possible inconsistencies across reports by contacting the authors.

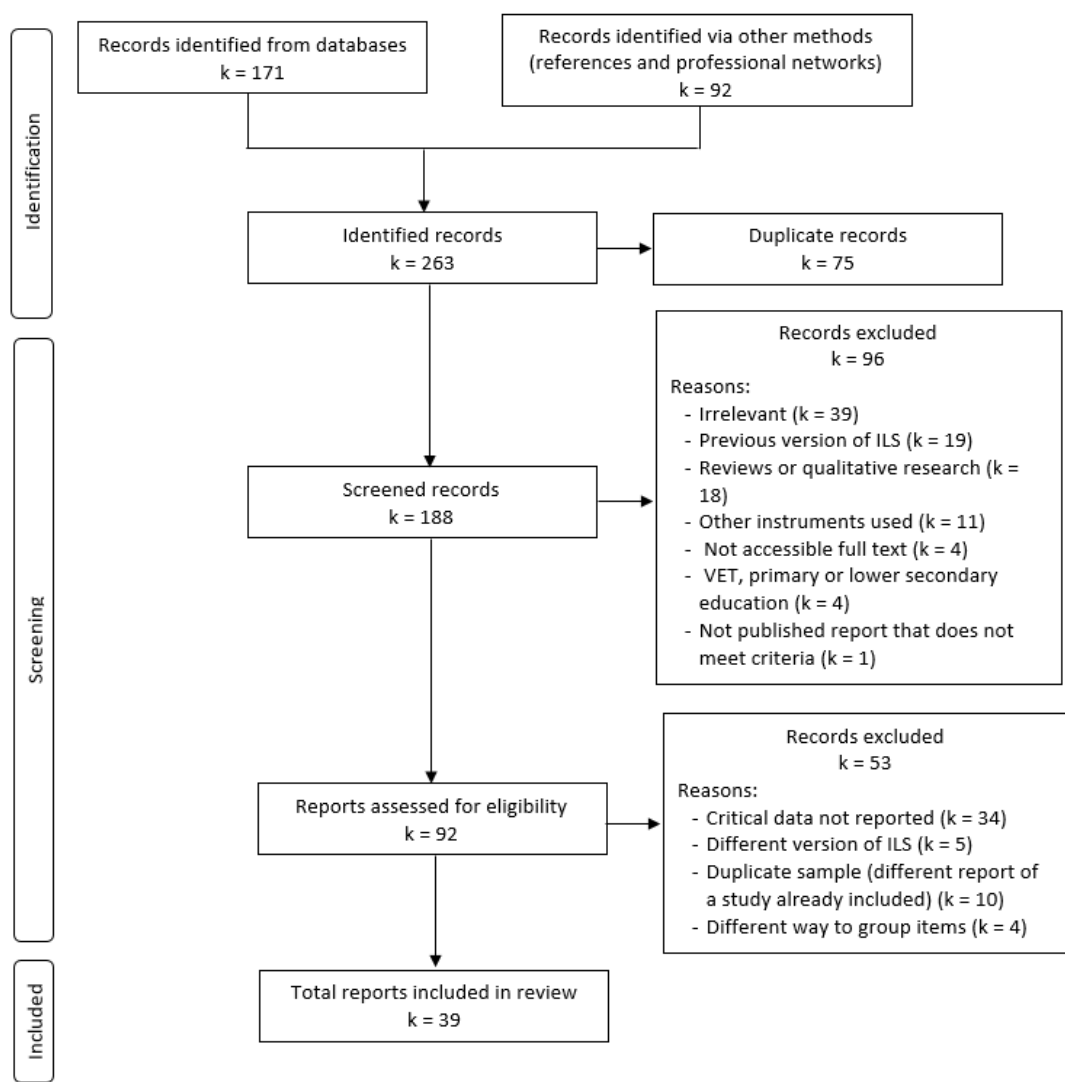
The substantive characteristics that were coded were: a) country where the study was conducted; b) educational setting (higher education, health professionals' residency, or upper secondary education); c) mean age of the sample; d) percentage of girls and boys. As for the methodological characteristics, the following were coded: a) version of the ILS (60, 100 or 120-items); and b) language of the questionnaire. Finally, as for the extrinsic variables, the coded data were: a) publication status (the coding options were: published in a peer-reviewed journal, not published, published but with missing data); b) year of data collection, when available. In cases when factor analysis was performed, the reviewers also retained the method of extraction, total explained variance and rotation performed. In the open materials (Ciraso-Calí et al., 2025), a summary of the included studies is presented. The combined sample is composed of 56.7% girls and 43.3% boys; with a mean of 24.3 years ($SD = 7.82$); it should be noted that 15 studies did not report gender nor age. Concerning the territories, 43.35% of them live in Asia or Oceania; 37.17% in Northern

Europe; 10.5% in Central or South America; and 8.98% in South or East Europe.

Among the methodological characteristics, it is noteworthy that 19 of the 46 studies did not use the whole questionnaire, reporting

results from 3 to 15 subscales. Regarding language, 12 reports used the Spanish translation of the questionnaire; 9 used the ILS in Dutch; 5 in English; 3 in Chinese; 3 in Turkish; 2 in Portuguese; 2 in Finnish; in total, 16 languages were used.

Figure 1. Flow chart of study selection process



Quality assessment

The quality of the reports was assessed using an own adaptation of the Appraisal Tool for Cross-Sectional Studies (AXIS; Downes et al., 2016), which addresses study design and reporting quality as well as the risk of bias in cross-sectional study. The adapted tool was a checklist of 18 components, organized into five dimensions: introduction, methods, results, discussion and ethics.

The assessment was done at study level, and five reviewers were involved in risk of bias assessment. As discussed by the authors of AXIS (Downes et al., 2016), numeric rates because of assessment checklists are problematic; thus, an overall qualitative and subjective assessment was required, that was facilitated by the examination of each element of the checklist.

The quality assessment revealed some common strengths and weaknesses of the

research on learning patterns using the ILS. All 39 reports stated clearly the aims of the study, and design was considered overall appropriate (38 reports). In 35 of the papers, methods were sufficiently described to enable them to be replicated. All papers, except two of them, clearly stated the estimates that were used to determine statistical significance and precision.

On the other hand, only 6 reports presented enough data to infer that the sample was representative and size justified. Additionally, in 5 of the reports it was not clear the population to whom the results could be generalized, if the sample was representative. Also, regarding methods, other common weaknesses were not reporting how missing values were addressed (only 7 of the reports presented this information); and low response rates or not reporting response rate and information about non-responders (19 reports).

Regarding the instrument, 11 of the papers reported results from new translations of the ILS that were not published or piloted previously. These are studies that used the tool in other languages (such as versions in Albanian, Japanese, Chinese, Swedish, among others). However, this does not imply lesser quality, if enough details about translation, adaptation and procedures are provided (which was the case).

As for the results, the major weakness found was that in 19 reports, not all results reported were totally consistent: i.e., some constructs with $\alpha < .60$ were reported and later used in analyses. As discussed later in this article, this issue regards basically the same ILS subscales throughout all the primary sources. Out of the 39 papers, 33 reported a description of the sample, although not always a complete one.

In 18 of the papers, limitations of the study were not discussed. And finally, ethical aspects such as possible conflicts of interests of the author's or the ethical approval were not generally reported (however, authors generally confirmed that minimum ethical considerations such as informed consent were considered).

In general, the quality assessment revealed information that could raise some concerns about the external validity of the studies; or at least, caution should be used when interpreting results of the research, since it could be missing out part of the targeted population. Otherwise, no other risk of bias (that could affect this meta-analysis) was considered relevant. The individual quality assessments will be provided at request to the corresponding author for purposes of replicability and further research.

Statistical analysis

Different analyses were conducted for each of the 24 possible subscales. The random-effects model was determined to be theoretically appropriate since it did not imply the assumption that the studies included in the meta-analysis were functionally identical and they analyzed the same effect size (Botella & Sánchez Meca, 2015); and because of the usefulness of this meta-analysis to provide some guidance for different studies, others than the included ones. In addition, the general convergence of results between random-effects models and varying coefficient model, as seen in Gisbert-Pérez et al. (2022), was considered.

Paule and Mendel's estimation method (PM) was used, since it is considered robust regarding other methods, such as DerSimonian-Laird, and has good performances in terms of bias (Veroniki et al., 2014).

As for transformation, Bonett's (2002) one was applied to normalize the distribution of reliability coefficients and to stabilize their variances; being the combination of random-effect models and Bonett's transformation already explored in literature and discussed in Sánchez-Meca et al. (2013). All results were finally back transformed to alpha metrics.

The process of analysis consisted of calculating a weighted average effect size (with the inverse-variance weighting method) with its 95% confidence interval, the heterogeneity test Q , and the I^2 index to evaluate the degree of homogeneity of the

single effect sizes around the average estimate (Higgins et al., 2003).

To explain heterogeneity, the influence of moderating variables was analyzed by means of simple weighted regression analysis for the continuous moderator variables and meta-

ANOVA for the categorical variables, as shown in Table 2. For subgroup analysis, separate fixed-effects meta-analyses were later performed, in each of the categories of the variables where a significant moderation effect was found.

Table 2. Variables analyzed as possible moderating factors

Dimension	Moderating variables	Categories (if categorical) and model
Substantive characteristics	Mean age of students	Meta-regression.
	Territory	North Europe; America; South and East Europe; Asia and Oceania. Meta-ANOVA.
	Specific domain (only for higher education)	Health; social sciences; engineering; mixed sample. Meta-ANOVA.
Methodological characteristics	Version of the ILS	60-items; 100-items; 120-items. Meta-ANOVA.
	Language of the questionnaire	Dutch; English; Spanish; Other languages. Meta-ANOVA.
Extrinsic characteristics	Publication status	Published in a peer-reviewed journal; not published; published but with missing data. Meta-ANOVA.
	Year of data gathering	Meta-regression.

Possible publication bias was tested using Egger’s regression test; because of its low statistical power with a reduced number of studies ($k < 30$), a significance level of .10 was adopted. In addition, publication status was used as a moderating variable for meta-ANOVA, to analyse its influence on reported reliability.

Results

Publication bias

The results of the Egger’s regression test on funnel plot asymmetry did not suggest any publication bias that could threaten the validity of our results; for all the subscales, the intercept was non-significant (it was established a stricter criterion for near-significance, and p was $> .10$ in all tests. Detailed outputs are available in the open materials (Ciraso-Calí et al., 2025).

However, further analyses were carried out to ascertain if the publication status of the included studies could influence the alpha

coefficients. For 8 of the 24 subscales, significant differences ($p < .05$) were found between alphas of published reports, not published reports, or reports which were published but with some critical missing data. In all these subscales, published articles show greater consistence coefficients than the other groups, suggesting that there may be a publication bias in some cases. The differences in “external regulation of learning results” and “lack of regulation” appear to be noteworthy, with a combined alpha among unpublished studies below .60. This supports our decision to include non-reported studies and data, to compensate for this possible bias.

Combined reliability

Table 3 shows the main summary statistics for the alpha coefficients obtained for each ILS subscale. The meta-analyses yielded combined reliability coefficients ranging from $\alpha = .55$ (for “personal interest”) to $\alpha = .83$ (for “deep processing”).

Main subscales, from the 16-subscale structure, obtained better reliability performance: for instance, “stepwise processing” with a combined $\alpha = .77$, as opposed to “memorizing & rehearsing” ($\alpha = .73$) and “analyzing” ($\alpha = .68$). The original coefficients are also reported in Table 3; in some cases, mostly in processing strategies, the combined reliability estimates are close to the original ones. On the other hand, in other subscales (such as “lack of regulation” and

most subscales of learning orientations) the combined α is smaller. Heterogeneity was significant (according to the Q statistics) in all primary analyses, which indicates substantial variations in consistency across the included populations. All the I^2 statistics are greater than 90% (except for “analyzing”), suggesting that this heterogeneity has a considerable impact on the precision of the estimates. To explain the heterogeneity, moderator analyses were performed.

Table 3. Average alpha coefficients, 95% confidence intervals, and heterogeneity statistics for all subscales

Dimension	Subscale	<i>k</i>	Combined α	Original α	95% CI		Q	I^2
					LL	UL		
Processing strategies	Deep processing	25	.83	.85	.81	.85	377.51*	91.45%
	Relating & structuring	24	.79	.83	.76	.82	489.780*	95.21%
	Critical processing	25	.72	.72	.68	.76	928.84*	95.31%
	Stepwise processing	25	.77	.78	.72	.80	880.48*	96.59%
	Memorizing & rehearsing	25	.73	.79	.69	.77	590.95*	95.99%
	Analyzing	25	.68	.63	.65	.71	200.30*	89.93%
Regulation strategies	Concrete processing	32	.71	.71	.67	.74	678.86*	95.78%
	Self-regulation	31	.78	.79	.75	.81	1.346.69*	95.68%
	Self-regulation process & results	25	.73	.73	.69	.76	848.42*	93.30%
	Self-regulation learning content	25	.69	.73	.65	.73	373.48*	93.53%
	External regulation	30	.71	.68	.67	.74	734.39*	95.05%
	External regulation learning process	22	.59	.48	.53	.63	299.51*	91.98%
	External regulation learning results	22	.64	.65	.58	.68	213.76*	91.64%
Lack of regulation	42	.67	.72	.63	.71	739.20*	95.99%	

Note: *k*: number of studies included in each meta-analysis. Combined α : mean, weighted α , back transformed from Bonett's (2002) transformation. Original α : from Vermunt (1998), regular university (RU) study. 95% CI: 95% confidence interval around the mean coefficient (lower limit and upper limit). Q : Cochran's heterogeneity Q statistic (*Significance of heterogeneity <.001). I^2 heterogeneity index (%).

Table 3. Average alpha coefficients, 95% confidence intervals, and heterogeneity statistics for all subscales (*continued*)

Dimension	Subscale	<i>k</i>	Combined α	Original α	95% CI		<i>Q</i>	<i>I</i> ²
					LL	UL		
Conceptions of learning	Construction of knowledge	35	.73	.78	.70	.77	1.399.00*	96.38%
	Intake of knowledge	35	.70	.77	.67	.74	885.68*	95.76%
	Use of knowledge	32	.74	.70	.70	.77	1.331.35*	96.35%
	Stimulating education	35	.79	.88	.75	.82	1.093.82*	97.90%
	Cooperative learning	34	.78	.89	.75	.81	980.73*	97.04%
	Personally interested	31	.55	.57	.49	.61	759.71*	95.55%
Learning orientations	Certificate-oriented	29	.60	.76	.54	.65	481.40*	94.99%
	Self-test-oriented	27	.71	.84	.67	.75	541.28*	95.50%
	Vocation-oriented	30	.68	.69	.64	.72	461.87*	93.61%
	Ambivalent	30	.70	.82	.66	.73	426.87*	92.40%

Note: *k*: number of studies included in each meta-analysis. Combined α : mean, weighted α , back transformed from Bonett's (2002) transformation. Original α : from Vermunt (1998), regular university (RU) study. 95% CI: 95% confidence interval around the mean coefficient (lower limit and upper limit). *Q*: Cochran's heterogeneity *Q* statistic (*Significance of heterogeneity <.001). *I*² heterogeneity index (%).

Moderation analyses

In Appendix, the outputs of moderator analyses for the 16 main subscales are presented. Greater variability is observed in learning conceptions and orientations, rather than in the strategies. Overall, the subscales where more variability is explained are "construction of knowledge", "stimulating education" and "certificate-oriented". This last subscale should be highlighted: as previously observed, it presents a combined alpha of .60; and furthermore, its reliability drops significantly as the average age of the participants rises, especially in the health care sector; and when measured with the ILS60, a combined alpha of only .41 is reached.

Among all factors, age stands out; as it maintains an inverse relationship with alpha coefficients in these three subscales, as well as in "lack of regulation". The territory does not

seem to affect the reliability of the questionnaire in general, except in the "personally interested" subscale. In this case, we see first that alpha scores > .70 are not obtained in any territory; and secondly, large differences between the results obtained in Northern Europe, on the one hand, and America and Southern Europe, on the other.

When looking at the methodological variables, the expected effect on reliability of the item reduction in the 100-item and 60-item versions of the ILS is observed. However, in the processing strategies such variation is not that noticeable; and among the regulation strategies, differences were only detected in the "lack of regulation" subscale, where both the ILS100 and the ILS120 had significantly higher alpha coefficients.

Discussion

The discussion addresses the questions raised in this study and concludes with suggestions for improvement, based on the results obtained and considering the background of this line of research.

Are ILS subscales' scores reliable across different applications?

From the analysis of combined alphas emerged that most subscales reach, globally, alpha coefficients with values above the minimum acceptable for the purposes of the ILS (Cicchetti, 1994). However, some of them have alphas lower than .70: “analyzing”, “self-regulation of learning content”, “external regulation of learning process”, “external regulation of learning results”, “lack of regulation”, “personally interested”, “certificate-oriented” and “vocation-oriented”. Thus, statements about regulatory strategies and motivational orientation do not seem clear or consistently formulated for international understanding. Compared with the stronger performance of processing strategies, these weaker subscales highlight uneven measurement quality across the instrument, and such items should be improved and/or their quantitative measurement should be complemented with qualitative approaches based on interviews and/or systematic observations.

The most problematic subscale in terms of reliability is clearly “personally interested” and it is noticeable that even in the first application of the original ILS, the alpha value was below .60. It is strongly advisable to revise the conceptualization of the subscales and the wording of the items, especially as it is such an important component of the meaning-directed learning pattern. An aspect that seems clear, as already pointed out by Martínez-Fernández and Vermunt (2015), is the very conceptualization of the personal interest, as well as the possible effect of different learning situations: items such as “*I see these studies as sheer relaxation*” or “*I do these studies out of sheer interest in the topics that are dealt with*” probability do not suit the feeling of university

students, dealing with demanding learning tasks. Their intrinsic motivation may be more related to the value they assign to the task; even if the interest for the topic is high, it could be not enough to consider it “relaxing” in the long-term learning commitment.

It should be acknowledged that a lower alpha does not necessarily mean that the subscale does not provide trustworthy information; the relevance and general quality of the instrument can be also substantiated considering its external validity, for instance its well-proven relations with academic grades (Busato et al., 2000; Donche et al., 2014; Martínez-Fernández & Vermunt, 2015; Vega-Martínez et al., 2023). However, when comparing these external indicators with the internal inconsistencies found, it becomes clear that some subscales may produce less stable inferences across samples, and the statistical power of the techniques that are usually used to configure the learning patterns (mainly principal component analysis or factor analysis) can be affected by low reliability coefficients. Therefore, it would be a considerable step forward to improve the reliability of some of these subscales, to yield more precise results on the learning patterns, and, therefore, make a more accurate assessment of learning processes and identify potential improvements from the point of view of educational intervention.

How can the variability among reliability coefficients be explained, based on substantive, methodological and extrinsic factors?

The moderation results show that the cultural dimension is not affecting the precision of the measurement in most cases: in different territories, the items of the subscales are related to each other in a similar way (as already identified by Shum et al., 2024). Moreover, the translation of ILS into different languages does not seem to imply a decrease in the reliability coefficients, except in the case of “stimulating education”. For this subscale, however, there could be an effect of the ILS version, since three of the five primary studies

that were included in this analysis (Boyle et al., 2003; Richardson, 2007; Richardson, 2010) used the 100-items version. In this regard, and considering the internationalization of higher education, the ILS appears to be a powerful tool for identifying learning patterns in international students and, on that basis, designing actions for improvement, adaptation to the new context and personalizing the learning experience based on an understanding of the students' own beliefs and learning actions, thereby reducing friction in the new context.

Conversely, students' mean age deserves special attention as a factor for fluctuations in alpha coefficients. Results indicate that when older students respond to the questionnaire, reliability is significantly lower in “lack of regulation”, “construction of knowledge”, “stimulating education” and “certificate-oriented”; which suggests that these subscales could be understood differently by older students, and reveal more complex concepts as students mature, gain experience in learning processes, and as the learning content gets more complex as well. In this regard, the identification of learning patterns with the ILS must take age into account when interpreting data and defining educational guidelines for improvement.

Another explanation could be found in a feature of alpha coefficient: the homogeneity of responses attenuates its estimation. As Vermunt (2005) already pointed out, there is a relationship between the respondents age and the learning patterns; being older students more likely to adopt a meaning-directed learning pattern. It could be possible that groups of older students give responses that are more homogeneous in these subscales (for instance, responding more closely to the positive pole in “construction of knowledge”).

Students mean age, specific domain and territory are combined, as moderating factors, in the explanation of a significant amount of variability for some of the conceptions of learning and learning orientations. Especially, “construction of knowledge” produces less

consistent scores among older students; “personally interested” has better reliability in Northern Europe; and “certificate-oriented” present less consistent scores among older students, and students who are studying disciplines related to health and social sciences. In this regard, the use of ILS should be combined with qualitative techniques that allow us to refine our understanding of learning, both with young and adult learners (some methods have been applied in Ciraso-Calí et al., 2026).

Finally, another key finding is that as years pass by, the reliability of two subscales significantly decreases: “deep processing” and “stimulating education”. One possible explanation would be that other characteristics of the studies or the samples constitute confounding variables for this relationship: for example, some of the most recent reports that were included in the meta-analysis used the ILS-60 (such as Martínez-Fernández et al., 2020; or Vega Martínez, 2022), and the reduction of the number of items affects negatively the same subscales. Likewise, the most recent studies included in the meta-analysis used an ILS version in a different language, and the language of the questionnaire is a factor for the decrease of alpha values for the subscale of “stimulating education”. Another tentative explanation is also possible: that the concepts involved in this strategy and learning conception might be acquiring a slightly different meaning, since the original definition of the items. This could be the case for “deep processing”: two items refer to “*the textbook used in that course*”, while a lot of university courses may not have, in fact, “textbooks”, and rather rely on different teaching materials and online resources, including multimedia (Liu et al., 2021). In general, items in this subscale needs an adaptation considering the overwhelming expansion of cooperative learning and other forms of teamwork (Namaziandost et al., 2020), as well as active, experiential and creativity-oriented methods (Habib et al., 2021). These methodological shifts across studies likely contribute to variability and

introduce further threats to comparability, and as mentioned in the discussion of question 1, surely the design of semi-structured interviews, as well as systematic observations in authentic learning situations, will provide us with clearer evidence regarding the identification of the different dominant learning patterns in authentic learning environments.

How can researchers improve the reliability of the subscales?

Findings indicate that the use of 16 subscales seems to be the most appropriate option for the ILS. However, the items referring to learning orientations and lack of regulation should be improved based on a thorough discussion of the meaning of these constructs. Likewise, the subscales of learning conceptions are susceptible to revision. In particular, the contrast between the stronger performance of processing subscales and the weaker results for motivational or regulatory components suggests uneven construct definition that merits closer examination.

Considering all the results, the main revisions of the instrument should be aimed at improving internal consistency of all learning orientations and lack of regulation, especially when studying older students, and with reduced versions of the ILS. Both the construct “personally interested” and the wording of items would benefit from a thorough revision; as already suggested by Martínez-Fernández and Vermunt (2015), it is possible that some translations such as “*enrichment*” are affecting the univocality of items. To increase the alpha coefficients, it would be advisable to adjust the number of items in each subscale to the complexity of the constructs.

Limitations and implications for educational practice and research

As for limitations, especially in the moderation results caution is advisable to the observational nature of the analyses. Furthermore, multiple regression analyses were not possible due to the considerable amount of missing data in the moderating variables, and therefore a reduction of the

studies that could be included in each model. In this sense, the authors emphasize the importance of reporting all the relevant details in empirical reports, to improve replicability of research and facilitate meta-analyses with more refined and precise multilevel and multivariate techniques. Incomplete reporting of sample characteristics, age distributions, version differences, and translation practices across primary studies limits the precision and interpretability of moderation analyses and introduces additional threats to validity. It would be interesting to report total score variance as well, to use it as covariate in future reliability meta-analysis.

Furthermore, it should be noted that the generalization of the conclusions can be challenged by the high heterogeneity found in this meta-analysis. Such heterogeneity reduces the possibility to make claims about the general reliability of the subscales; and again, the incomplete reporting of the primary studies difficult the complete explanation of this heterogeneity.

Despite the limitations encountered, this is the first meta-analytic study on the reliability of ILS scores, which can guide the use of the instruments in the educational practice, especially in Higher Education contexts. Based on the results, some guidelines have been developed.

When using and interpreting ILS results for educational purposes, it is advisable to focus on the main subscales rather than the smaller ones, to work with more reliable scores. For instance, “deep processing” should be considered as a composite of “relating & structuring” and “critical processing”; “stepwise processing” as a combination of “memorizing & rehearsing” and “analyzing”; “self-regulation” as encompassing both process and content-related aspects; and “external regulation” as integrating learning process and outcome regulation.

When the primary goal of the educator is the student’s individual self-reflection based on their scores, the extended version (ILS120) is recommended. Conversely, when the purpose

is to obtain an overview of the learning patterns of a group, the shorter version (ILS60) offers a more practical and time-efficient alternative while still providing a global perspective.

It is important to note that the “personally interested” subscale should not be used in isolation, as its reliability is limited across all territories, specific domains, versions of the instruments and age ranges. However, its factorial grouping with other subscales may offer insights into learning patterns of students. For instance, its combination with self-test-orientation generated in a recent study (Ciraso-Calí et al., 2026) the understanding of a challenge-oriented motivation towards difficult learning tasks; and prompted the selection of teaching strategies to support this orientation, that was prevalent even among students who were not otherwise intrinsically motivated.

For older adult students, particularly in health sciences and social sciences programs, complementary instruments assessing motivations and study strategies are advisable to compensate for the lower reliability of the subscales “deep processing” and “certificate-orientation”. Further triangulation with other measures - such as selected subscales from the MSLQ (Pintrich et al., 1991), other instruments for academic motivation described by Sánchez-Bolívar and Martínez-Martínez (2022), or qualitative approaches like think-aloud protocols - can enhance the validity of interpretations and support more comprehensive educational interventions.

Future research could be directed towards the analysis of the psychometric properties of the existing adaptations of the ILS for different contexts, such as Vocational Education and Training, Primary Education or life-long learning; to discuss the domain of applicability of the model and the instrument. Furthermore, future systematic reviews could focus on the factorial configuration of the learning patterns, once the consistency of the subscales has been investigated.

It is worth mentioning that internal consistency is just one way to inform about reliability. Other evidence can be gathered, such as test-retest correlations; as well as other indicators of accuracy of measures, which are based on the factorial structure of the subscale and do not rely on the strict assumptions of alpha coefficient (Doval et al., 2023). The diversity of factor loadings among items in many of the ILS subscales is relevant; therefore, it could be appropriate to explore alternative ways to calculate the score of each subscale, that can be more precise in this case; and to use different determinacy and reliability indices for these scores, as proposed by Ferrando and Lorenzo-Seva (2017).

Likewise, a wider and more comprehensive methodological gaze can integrate different strategies to gain a deeper understanding of the precisions and validity of the model: for instance, the collection of qualitative data (from observations and interviews, as in Martínez-Fernández et al., 2018) that would allow us to access the most internal and personal processes in terms of learning processes. Overall, these limitations highlight the need for stronger methodological standards and more transparent reporting to reinforce the validity of the conclusions derived from future applications of the ILS.

Finally, future research in this area should strengthen the discussion of learning profiles using a mixed-methods approach, with the results being discussed by teams of policy makers, curriculum designers, teacher trainers and other relevant stakeholders to design adjusted teaching interventions that promote the most meaningful learning processes. Based on the results of this meta-analysis, some aspects to consider are the origin of the students, their age, and their understanding of their learning beliefs as the basis for the actions that are activated for learning.

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References

- *Ahmedi, S. (2020). *A cross-cultural study on learning patterns and social-emotional learning of Balkan students in Secondary Education*. [Unpublished doctoral project]. Universitat Autònoma de Barcelona.
- *Ajisukmo, C. R. P., & Vermunt, J. (1999). Learning styles and self-regulation of learning at University: An Indonesian study. *Asia Pacific Journal of Education*, 19(2), 45-59. <https://doi.org/10.1080/0218879990190205>
- *Alves De Lima, A., Bettati, M. I., Baratta, S., Falconi, M., Sokn, F., Galli, A., Barrero, C., Cagide, A., & Iglesias, R. (2006). Learning strategies used by cardiology residents: assessment of learning styles and their correlations. *Education Health: Change in Learning and Practice*, 19(3), 289-297. <https://doi.org/10.1080/13576280600937788>.
- Botella, J., & Sánchez-Meca, J. (2015). *Meta-análisis en ciencias sociales y de la salud*. [Meta-analysis in social and health sciences]. Síntesis.
- Bonett, D. G. (2002). Sample size requirements for testing and estimating coefficient alpha. *Journal of Educational and Behavioral Statistics*, 27(4), 335-340. <https://doi.org/10.3102/10769986027004335>
- *Boyle, E., Duffy, T., & Dunleavy, K. (2003). Learning styles and academic outcome: The validity and utility of Vermunt's Inventory of Learning Styles in a British higher education setting. *British Journal of Educational Psychology*, 73(2), 267-290. <https://doi.org/10.1348/00070990360626976>
- Busato, V. V., Prins, F. J., Elshout, J. J., & Hamaker, C. (2000). Intellectual ability, learning style, personality, achievement motivation and academic success of psychology students in higher education. *Personality and Individual Differences*, 29(6), 1057-1068. [https://doi.org/10.1016/S0191-8869\(99\)00253-6](https://doi.org/10.1016/S0191-8869(99)00253-6)
- Ciraso-Calí, A., Martínez-Fernández, J.R., García-Ravidá, L., Vega Martínez, A., Quesada-Pallarès, C., & Vermunt, J.D. (2023). *Reliability coefficients from the Inventory of Learning patterns of Students (ILS)*. CORA. Repositori de Dades de Recerca, V2. <https://doi.org/10.34810/data634>
- Ciraso-Calí, A., Martínez-Fernández, J.R., García-Ravidá, L., Vega Martínez, A., Quesada-Pallarès, C., & Vermunt, J.D. (2024). *Reliability generalization of Vermunt's Inventory of Learning Patterns: a meta-analysis of alpha coefficients*. PROSPERO. <https://www.crd.york.ac.uk/PROSPERO/view/CRD42021239103>
- Ciraso-Calí, A., Martínez-Fernández, J. R., García Ravidá, L. B., Vega-Martínez, A., Quesada-Pallarès, C., & Vermunt, J. D. (2025). *Open material of manuscript "Reliability Generalization of the Inventory of Learning Patterns of Students: A Meta-analysis of Alpha Coefficients"*. PsychArchives. <https://doi.org/10.23668/psycharchives.21445>
- Ciraso-Calí, A., Quesada-Pallarès, C., & Martínez-Fernández, J.R. (2026). El modelo de patrones de aprendizaje en Educación Primaria: Una aproximación con métodos mixtos [The learning patterns model in Primary Education: A mixed-methods approach]. *Revista de Investigación Educativa*, 44 (in press). <https://doi.org/10.6018/rie.656951>
- Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessments instruments in psychology. *Psychological Assessment*, 6(4), 284-290. <https://doi.org/10.1037/1040-3590.6.4.284>
- Conn, V. S., Valentine, J. C., Cooper, H. M., & Rantz, M. J. (2003). Grey literature in meta-analysis. *Nursing Research*, 52(4), 256-261. <https://doi.org/10.1097/00006199-200307000-00008>

- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297–334. <https://doi.org/10.1007/BF02310555>
- Cronbach, L. J., & Shavelson, R. J. (2004). My Current Thoughts on Coefficient Alpha and Successor Procedures. *Educational and Psychological Measurement*, 64(3), 391-418. <https://doi.org/10.1177/0013164404266386>
- *De la Barrera, M.L., Riccetti, A. E. (2020). De decisiones y aprendizajes en la formación de profesores de educación física: poniendo en juego la metacognición. *Revista de Educación Física*, 9(3), 63-75. <https://revistas.udea.edu.co/index.php/viruf/article/view/340869>
- Delgado Orrillo, Y., Ciraso-Calí, A., Quesada-Pallarès, C., Matos Nunes, T.C., de Oliveira Figueredo, G., García-Orriols, J., Rodrigues Guilam, M., & Martínez-Fernández, J.R. (2023). Learning patterns of postgraduate students in public health: relationships with identity, training and the work of teachers in Brazil. *Medical Education*, 24(4). <https://doi.org/10.1016/j.edumed.2023.100829>
- *Dolly Arancibia, M. (2020). *Informe de avance: Patrones de aprendizaje y educación superior. Influencia de los patrones de aprendizaje en el rendimiento académico de estudiantes universitarios de primer ciclo* [Progress report: Learning patterns and higher education. Influence of learning patterns on the academic performance of first cycle university students]. Unpublished research report.
- Donche, V., Coertjens, L., Van Daal, T., De Maeyer, S., & Van Petegem, P. (2014). Understanding differences in student learning academic achievement in first year higher education: an integrative research perspective. In D. Gijbels, V., Donche, J. T. E. Richardson, & J. Vermunt, (Eds.) *Learning Patterns in Higher Education. Dimensions and research perspectives* (pp. 214-231). Routledge.
- *Donche, V., Coertjens, L., & Van Petegem, P. (2010). Learning pattern development throughout higher education: A longitudinal study. *Learning and Individual Differences*, 20(3), 256-259. <https://doi.org/10.1016/j.lindif.2010.02.002>
- *Donche, V., & Van Petegem, P. (2009). The development of learning patterns of student teachers: a cross sectional and longitudinal study. *Higher Education*, 57, 463–475. <https://doi.org/10.1007/s10734-008-9156-y>
- Doval, E., Viladrich, C., & Angulo-Brunet, A. (2023). Coefficient Alpha: The resistance of a classic. *Psicothema*, 35(1), 5-20. <https://doi.org/10.7334/psicothema2022.321>
- Downes, M. J., Brennan, M. L., Williams, H. C., & Dean, R. (2016). *Development of a critical appraisal tool to assess the quality of cross sectional studies (AXIS)*. *BMJ Open*. <https://doi.org/10.1136/bmjopen-2016-011458>
- *Edelbring, S. (2012). Measuring strategies for learning regulation in medical education: scale reliability and dimensionality in a Swedish sample. *BMC Medical Education*, 12, 76. <https://doi.org/10.1186/1472-6920-12-76>
- *Elisondo, R., De la Barrera, M.L., Rigo, D.Y., Kowszky, D.I., Fagotti, E., Riccetti, A., & Siracusa, M.R. (2016). Estudiantes hoy, entre Facebook, Google y Metacognición. Ideas para innovar en la Educación Superior. *Revista de Docencia Universitaria*, 14(1), 225-244. <https://doi.org/10.4995/redu.2016.5800>
- Ferrando, P. J., & Lorenzo-Seva, U. (2017). Assessing the quality and appropriateness of factor solutions and factor score estimates in exploratory item factor analysis. *Educational and Psychological Measurement*, 27(5), 1-19. <https://doi.org/10.1177/0013164417719308>
- *Fryer, L. K., Ginns, P., & Walker, R. (2016). Reciprocal modelling of Japanese university students' regulation strategies and motivational deficits for studying. *Learning and Individual Differences*, 51, 220–228. <https://doi.org/10.1016/j.lindif.2016.08.032>

- *Gaeta González, M. L., Reyes Vergara, M. L., González Rabino, M. L., García-Béjar, L., Espinosa Jiménez, M., Gutiérrez Niebla, M. I., & Benítez Ríos, Y. T. (2020). Perspectiva de futuro, patrones de aprendizaje y rendimiento académico en estudiantes universitarios mexicanos [Time Perspective, Learning Patterns and Academic Achievement in Mexican University Students]. *Estudios sobre Educación*, 39, 9-31. <https://doi.org/10.15581/004.39.9-31>
- *Gamboa-Salcedo, T., García-Durán, R., & Peña-Alonso, Y. R. (2012). Traducción al español y análisis de confiabilidad del inventario de estilos de aprendizaje de Vermunt en residentes de pediatría [Spanish translation and reliability analysis of Vermunt's inventory of learning styles in pediatric residents]. *Investigación en Educación Médica*, 1(2), 57-63. <https://doi.org/10.22201/fm.20075057e.2012.02.00003>
- García-Ravidá, L. B. (2017). *Patrones de aprendizaje en universitarios latinoamericanos: Dimensión cultural e implicaciones educativas* [Learning patterns in Latin-American university students: Cultural dimension and educational implications] [Doctoral Dissertation]. Universitat Autònoma de Barcelona, Spain. <https://www.tesisenred.net/handle/10803/454839>
- Gisbert-Pérez, J., Martí-Vilar, M., Merino-Soto, C., & Vallejos-Flores, M. (2022). Reliability Generalization Meta-Analysis of Internet Gaming Disorder Scale. *Healthcare*, 10(10), 1992. <https://doi.org/10.3390/healthcare10101992>
- *Gülpinar, M. A. (2014). Klinik öncesi dönem tip fakültesi öğrencilerinin öğrenme stilleri [Learning Styles of Preclinical Medical Students]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi [H. U. Journal of Education]*, 29(3), 68-80.
- Habib, M. K., Nagata, F., & Watanabe, K. (2021). Mechatronics: Experiential Learning and the Stimulation of Thinking Skills. *Education Sciences*, 11(2), <https://doi.org/10.3390/educsci11020046>
- Hederich-Martínez, C., & Camargo-Urbe, A. (2019). Revisión crítica del modelo de patrones de aprendizaje de J. Vermunt [Critical revision of J. Vermunt's model of learning patterns]. *Revista Colombiana de Educación*, 77. <https://doi.org/10.17227/rce.num77-9469>
- *Helle, L., Laakkonen, E., Tuijula, T., & Vermunt, J. D. (2013). The developmental trajectory of perceived self-regulation, personal interest, and general achievement throughout high school: a longitudinal study. *British Journal of Educational Psychology*, 83, 252-266. <https://doi.org/10.1111/bjep.12014>
- *Juklova, K., Vondroušová, R., & Henter, R. (2017). Learning patterns of Czech and Romanian students within the context of a cross cultural comparison. *8th ICEEPSY 2017 The International Conference on Education & Educational Psychology*. <http://dx.doi.org/10.15405/epsbs.2017.10.36>
- *Kalaca, S., & Gulpinar, M. (2011). A Turkish study of medical student learning styles. *Education for Health*, 24(3), 1-11. <https://doi.org/10.4103/1357-6283.101429>
- *Konings, K. D., Brand-Gruwel, S., & Elen, J. (2012). Effects of a school reform on longitudinal stability of students' preferences with regard to education. *British Journal of Educational Psychology*, 82, 512-532. <http://dx.doi.org/10.1111/j.2044-8279.2011.02044.x>
- *Kumar Chakrabarti, A. (2017). *Learning style in relation to course experience, aptitude in chemistry and learning outcome* [unpublished PhD dissertation]. Department of Education, University of Calcutta.
- *Law, D. C. S., & Meyer, J. H. F. (2010). Adaptation and validation of the Inventory of Learning Styles for quality assurance in a Hong Kong post-secondary education context. *Quality in Higher Education*, 16, 269-283.

- <http://dx.doi.org/10.1080/13538322.2010.506717>
- Liu, J., Wang, C., & Wu, Y. (2021). *Construction and Optimization of Higher Education Management System Based on Internet Video Online Technology*. Scientific Programming. <https://doi.org/10.1155/2021/5520662>
- López-Ibáñez, C., López-Nicolás, R., Blázquez-Rincón, D.M., & Sánchez-Meca, J. (2024). Reliability generalization meta-analysis: Comparing different statistical methods. *Current Psychology*, 43, 18275–18293. <https://doi.org/10.1007/s12144-023-05604-y>
- López Pina, J. A., Sánchez-Meca, J., & López-López, J. A. (2012). Métodos para promediar coeficientes alfa en los estudios de generalización de la fiabilidad. *Psicothema*, 24(1), 161-166.
- *Lycke, K. H., Grøttum, P., & Strømsø, H. I. (2006). Student learning strategies, mental models and learning outcomes in problem-based and traditional curricula in medicine. *Medical Teacher*, 28(8), 717-722. <https://doi.org/10.1080/01421590601105645>
- *Marambe, K. N., Vermunt, J. D., & Boshuizen, H. P. A. (2012). A cross-cultural comparison of student learning patterns in higher education. *Higher Education*, 64, 299–316. <https://doi.org/10.1007/s10734-011-9494-z>
- Martínez-Fernández, J. R. (2019). El modelo patrones de aprendizaje: Estado actual, reflexiones y perspectivas desde el territorio de Iberoamérica [The learning patterns model: Current state, reflections and perspectives from the territory of Ibero-America]. *Revista Colombiana de Educación*, 77(1). <https://doi.org/10.17227/rce.num77-9953>
- *Martínez-Fernández, J. R., Ciraso-Calí, A., & García-Orriols, J. (2020). *Patrones de aprendizaje y factores personales asociados: una exploración en profesores y estudiantes de la Fiocruz (Brasil)* [Learning patterns and associated personal factors: an exploration with teachers and students of Fiocruz (Brazil)]. Unpublished research report.
- *Martínez Fernández, J. R., & García Ravidá, L. (2012). Patrones de aprendizaje en estudiantes universitarios del Máster de Educación Secundaria: variables personales y contextuales relacionadas [Learning patterns in students of the Master on Secondary Education: personal and contextual related variables]. *Profesorado: Revista de Currículum y Formación del Profesorado*, 16(1), 165-182.
- Martínez-Fernández, J. R., García-Ravidá, L. B., García-Orriols, J., & Martí-Garbayo, L. (2018). Desarrollo personal y aprendizaje: desafíos a la escuela desde una mirada longitudinal a los patrones de aprendizaje [Personal development and learning: Challenging the school from a longitudinal approach to learning patterns]. *Contextos de Educación*, 20(25), 45-57.
- Martínez-Fernández, J. R., García-Ravidá, L. B., González Velázquez, L., Badia Martín, M. (2025). Approaches to the study, associated factors and academic performance in a sample of Mexican undergraduates from native communities. *Journal for the Study of Education and Development*, 48(4), 893-924. <https://doi.org/10.1177/02103702251382676>
- Martínez-Fernández, J. R., García-Ravidá, L. B., & Mumbardó Adams, C. (2019). Latin American undergraduates and learning patterns in the transition to higher education: an exploratory study in Colombia. *Electronic Journal of Research in Educational Psychology*, 17(3), 561-588. <http://dx.doi.org/10.25115/ejrep.v17i49.2421>
- Martínez-Fernández, J. R., Noguera-Fructuoso, I., Ciraso-Calí, A., & Vega-Martínez, A. (2024). An exploratory study of university students' regulation profiles and satisfaction with flipped classrooms. *Revista Española de Pedagogía*, 82(287), 111-124. <https://doi.org/10.22550/2174-0909.3931>

- *Martínez Fernández, J. R., & Vermunt, J. (2015). A cross-cultural analysis of the patterns of learning and academic performance of Spanish and Latin-American undergraduates. *Studies in Higher Education*, 40(2), 278-295. <https://doi.org/10.1080/03075079.2013.823934>
- McNeish, D. (2018). Thanks coefficient alpha, we'll take it from here. *Psychological Methods*, 23(3), 412-433. <https://doi.org/10.1037/met0000144>
- Namaziandost, E., Homayouni, M., & Rahmani, P. (2020). The impacts of cooperative learning approach on the development of EFL learners' speaking fluency. *Cogent Arts & Humanities*, 7(1). <https://doi.org/10.1080/23311983.2020.1780811>
- Page, M. J., McKenzie, J. E., Bossuy, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Systematic Reviews*, 10(89). <https://doi.org/10.1186/s13643-021-01626-4>
- *Picarelli, A., Slaats, M., Bouhuijs, J., & Vermunt, J. D. (2006). Leerstijl en leeromgeving in het voortgezet onderwijs: Nederland en Vlaanderen vergeleken [Learning style and learning environment in secondary education: The Netherlands and Flanders compared]. *Pedagogische Studiën*, 83, 139-155
- Pintrich, P., Smith, D., García, T., & McKeachie, W. (1991). *A manual for the use of the motivated strategies for learning questionnaire (MSLQ)*. University of Michigan.
- *Richardson, J. T. E. (2010). Conceptions of learning and approaches to studying among white and ethnic minority students in distance education. *British Journal of Educational Psychology*, 80, 535-556. <https://doi.org/10.1348/000709910x489283>
- *Richardson, J. T. E. (2007). Mental models of learning in distance education. *British Journal of Educational Psychology*, 77, 253-270. <https://doi.org/10.1348/000709906x110557>
- *Rocha, M., & Ventura, M. (2011). Vermunt's Learning Styles: Searching for Portuguese College student's functioning. *Journal of Learning Styles*, 4(8), 40-70. <https://doi.org/10.55777/rea.v4i8.936>
- Ruiz-Bueno, C., & García-Orrriols, J. (2019). ¿Qué nos aporta el modelo de patrones de aprendizaje para el diseño de acciones formativas? [What does the learning patterns model contribute to the design of educational actions?]. *Revista Colombiana de Educación*, 77, 321-341. <https://doi.org/10.17227/rce.num77-9527>
- Sánchez-Bolívar, L., & Martínez-Martínez, A. (2022). Factors related to University Students' motivation and instruments for its evaluation: A systematic review. *Revista Electrónica Educare*, 26(2), 484-505. <https://dx.doi.org/10.15359/ree.26-2.26>
- Sánchez-Meca, J., López López, J. A. & López-Pina, J. A. (2013). Some recommended statistical analytic practices when reliability generalization studies are conducted. *British Journal of Mathematical and Statistical Psychology*, 66, 402-425. <https://doi.org/10.1111/j.2044-8317.2012.02057.x>
- Shum, A., Fryer, L. K., Vermunt, J. D., Ajisuksmo, C., Cano, F., Donche, V., Law, D. C., 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>
- Slaney, K. (2017). *Validating psychological constructs*. Palgrave Macmillan. <https://doi.org/10.1057/978-1-137-38523-9>
- *Song, Y., & Vermunt, J. (2021). A comparative study of learning patterns of

- secondary school, high school and college students. *Studies in Educational Evaluation*, 68. <https://doi.org/10.1016/j.stueduc.2020.10.0958>
- Vacha-Haase, T. (1998). Reliability generalization: Exploring variance in measurement error affecting score reliability across studies. *Educational and Psychological Measurement*, 58, 6-20. <https://doi.org/10.1177/00131644980580101002>
- *Vázquez, S. M. (2009). Rendimiento académico y patrones de aprendizaje en estudiantes de ingeniería [Academic Performance and Learning Styles in Engineering Students]. *Ingeniería y Universidad*, 13(1).
- *Vega-Martínez, A. (2022). *Evolución de los patrones de aprendizaje en universitarios iberoamericanos: Relaciones con la regulación, el estrés académico y el rendimiento* [Evolution of learning patterns in Ibero-American university students: Relationships with regulation, academic stress and achievement] [Doctoral dissertation]. Universitat Autònoma de Barcelona, Spain. <https://www.tesisenred.net/handle/10803/675467>
- Vega-Martínez, A., Martínez-Fernández J. R., & Coiduras-Rodríguez, J. L. (2023). Patrones de aprendizaje, estrés académico y rendimiento en universitarios de primer curso: un estudio exploratorio [Learning patterns, academic stress and achievement among first grade university students: An exploratory study]. *Educar*, 59(1), 163-178. <https://doi.org/10.5565/rev/educar.1527>
- *Vermetten, Y. J., Lodewijks, H. G., & Vermunt, J. D. (2001). The Role of Personality Traits and Goal Orientations in Strategy Use. *Contemporary Educational Psychology*, 26(2), 149-170. <https://doi.org/10.1006/ceps.1999.1042>
- *Vermetten, Y. J., Lodewijks, H. G., & Vermunt, J. D. (1999). Consistency and variability of learning strategies in different university courses. *Higher Education*, 37, 1-21. <https://doi.org/10.1023/A:1003573727713>
- *Vermunt, J. D. (1998). The regulation of constructive learning processes. *British Journal of Educational Psychology*, 68, 149-171. <https://doi.org/10.1111/j.2044-8279.1998.tb01281.x>
- Vermunt, J. (2005). Relations between student learning patterns and personal and contextual factors and academic performance. *Higher Education*, 49(3), 205-234. <https://doi.org/10.1007/s10734-004-6664-2>
- Vermunt, J. D. (2020). Surveys and retrospective self-reports to measure strategies and strategic processing. In D. L. Dinsmore, L. K. Fryer, & M. M. Parkinson (Eds.), *Handbook of strategies and strategic processing* (pp. 259-274). Routledge. <https://doi.org/10.4324/9780429423635-16>
- Vermunt, J. D., Bronkhorst, L. H., & Martínez-Fernández, J. R. (2014a). The dimensionality of student learning patterns in different cultures. En D. Gijbels, V. Donche, J. T. E. Richardson and J. D. Vermunt, *Learning Patterns in Higher Education: Dimensions and Research Perspectives* (pp. 33-55). Routledge.
- Vermunt, J. D., & Donche, V. (2017). A learning patterns perspective on student learning in higher education: State of the art and moving forward. *Educational Psychology Review*, 29(2), 269-299. <https://doi.org/10.1007/s10648-017-9414-6>
- *Vermunt, J. D., & Minnaert, A. (2003). Dissonance in student learning patterns: when to revise theory?. *Studies in Higher Education*, 28(1), 49-61. <https://doi.org/10.1080/03075070309301>
- Vermunt, J. D., Richardson, J. T. E., Donche, V., & Gijbels, D. (2014b). Students' learning patterns in higher education. Dimensions, measurement and change. In D. Gijbels, V., Donche, J. T. E. Richardson, & J. Vermunt, (Eds.) *Learning Patterns in Higher Education. Dimensions and research perspectives* (pp.295-310). Routledge.

- Vermunt, J. D., & Vermetten, Y. J. (2004). Patterns in student learning: Relationships between learning strategies, conceptions of learning, and learning orientations. *Educational Psychology Review*, 16, 359-384. <https://doi.org/10.1007/s10648-004-0005-y>
- Veroniki, A. A., Jackson, D., Viechtbauer, W., Bender, R., Bowden, J., Knapp, G., Kuss, O. Higgins, J. P., Langani, D., & Salantij, G. (2014). Methods to estimate the between-study variance and its uncertainty in meta-analysis. *Research Synthesis Methods*, 7(1), 55-79. <https://doi.org/10.1002/jrsm.1164>
- *Vilppu, H., Mikkila-Erdmann, M., & Ahopelto, I. (2013). The role of regulation and processing strategies in understanding science text among university students. *Scandinavian Journal of Educational Research*, 57(3), 246-262. <https://doi.org/10.1080/00313831.2011.637229>
- *Wijnen, M., Loyens, S. M., Smeets, G., Kroetze, M., & van der Molen, H. (2016). Comparing problem-based learning students to students in a lecture-based curriculum: Learning strategies and the relation with self-study time. *European Journal of Psychology of Education*, 32, 431-447. <https://doi.org/10.1007/s10212-016-0296-7>
- *Zeegers, P. (2004). Student learning in higher education: a path analysis of academic achievement in science. *Higher Education Research & Development*, 23(1), 35-56. <https://doi.org/10.1080/0729436032000168487>
- *Zeybek, G., & Şentürk, C. (2020). Analysis of pre-service teachers' learning styles according to Vermunt learning style model. *International Online Journal of Education and Teaching (IOJET)*, 7(2), 669-682.

Appendix

Table 4. Effect of moderator variables on the alpha coefficient of ILS main subscales

Dim	Subscale	Mean age	Territory	Specific domain	ILS version	ILS language	Year of data gathering
Processing strategies	Deep processing	$p = .231$	$p = .516$	$p = .884$	$p = .047$ $R^2 = 8.67\%$ $\alpha_{60} = .78 [.75; .80] (k = 3)$ $\alpha_{100} = .83 [.82; .84] (k = 5)$ $\alpha_{120} = .85 [.85; .86] (k = 17)$	$p = .522$	$k = 14$ $p < .001$ $Z = -4.73$ $R^2 = 93.6\%$ $I^2 = 11.3\%$
	Stepwise processing	$p = .894$	$p = .52$	$p = .459$	$p = .382$	$p = .337$	$p = .737$
	Concrete processing	$p = .173$	$p = .318$	$p = .218$	$p = .395$	$p = .618$	$p = .395$
Regulation strategies	Self-regulation	$p = .619$	$p = .843$	$p = .535$	$p = .129$	$p = .74$	$p = .113$
	External regulation	$p = .323$	$p = .528$	$p = .498$	$p = .977$	$p = .846$	$p = .937$
	Lack of regulation	$k = 29$ $p = .002$ $Z = -3.09$ $R^2 = 29.3\%$ $I^2 = 85.84\%$	$p = .087$	$p = .134$	$p = .023$ $R^2 = 7.74\%$ $\alpha_{60} = .54 [.49; .59] (k = 4)$ $\alpha_{100} = .66 [.65; .68] (k = 10)$ $\alpha_{120} = .71 [.70; .72] (k = 28)$	$p = .707$	$p = .199$
Learning conceptions	Construction of knowledge	$k = 23$ $p = .009$ $Z = -2.6$ $R^2 = 24.4\%$ $I^2 = 90.2\%$	$p = .53$	$p = .337$	$p = .007$ $R^2 = 15.2\%$ $\alpha_{60} = .62 [.57; .66] (k = 4)$ $\alpha_{100} = .71 [.70; .72] (k = 9)$ $\alpha_{120} = .80 [.79; .80] (k = 22)$	$p = .112$	$p = .133$
	Intake of knowledge	$p = .141$	$p = .846$	$p = .879$	$p = .017$ $R^2 = 12.74\%$ $\alpha_{60} = .58 [.53; .62] (k = 4)$ $\alpha_{100} = .66 [.64; .67] (k = 9)$ $\alpha_{120} = .75 [.74; .76] (k = 22)$	$p = .432$	$p = .414$
	Use of knowledge	$p = .067$	$p = .08$	$p = .346$	$p = .376$	$p = .479$	$p = .535$
	Stimulating education	$k = 23$ $p = .011$ $Z = -2.53$ $R^2 = 20.9\%$ $I^2 = 90.2\%$	$p = .756$	$p = .339$	$p < .001$ $R^2 = 43.53\%$ $\alpha_{60} = .58 [.53; .62] (k = 4)$ $\alpha_{100} = .72 [.71; .73] (k = 9)$ $\alpha_{120} = .83 [.83; .84] (k = 22)$	$p = .01$ $R^2 = 13.85\%$ $\alpha_{Dut} = .85 [.85; .86] (k = 7)$ $\alpha_{Eng} = .65 [.62; .68] (k = 3)$	$k = 21$ $p = .044$ $Z = -2.01$ $R^2 = 13.9\%$ $I^2 = 97.6\%$

					$\alpha_{Sp} = .77$ [.75; 78] ($k = 12$) $\alpha_{other} = .79$ [.78; 79] ($k = 13$)		
Learning orientations	Cooperative learning	$p = .470$	$p = .187$	$p = .444$	$p = .001$ $R^2 = 30.58\%$ $\alpha_{60} = .58$ [.52; .61] ($k = 4$) $\alpha_{100} = .79$ [.78; .80] ($k = 9$) $\alpha_{120} = .82$ [.81; 82] ($k = 21$)	$p = .248$ $p = .059$	
	Personally interested	$p = .263$	$p = .043$ $R^2 = 9.79\%$ $\alpha_{nEur} = .64$ [.62; .66] ($k = 7$) $\alpha_{Am} = .51$ [.47; .54] ($k = 12$) $\alpha_{seEur} = .56$ [.53; 59] ($k = 5$) $\alpha_{AsOc} = .61$ [.61; 63] ($k = 7$)	$p = .266$	$p = .663$	$p = .396$	$p = .843$
	Certificate-oriented	$k = 18$ $p = .011$ $Z = -2.55$ $R^2 = 27.5\%$ $I^2 = 90.1\%$	$p = .169$	$p = .043$ $R^2 = 12.92\%$ $\alpha_{health} = .49$ [.44; .53] ($k = 5$) $\alpha_{social} = .58$ [.56; .61] ($k = 13$) $\alpha_{misc} = .69$ [.67; 70] ($k = 5$)	$p = .003$ $R^2 = 22.35\%$ $\alpha_{60} = .41$ [.34; .48] ($k = 3$) $\alpha_{100} = .62$ [.60; .63] ($k = 9$) $\alpha_{120} = .67$ [.66; 68] ($k = 19$)	$p = .353$	$p = .232$
	Self-test-oriented	$p = .701$	$p = .071$	$p = .555$	$p = .003$ $R^2 = 22.09\%$ $\alpha_{60} = .57$ [.52; .61] ($k = 4$) $\alpha_{100} = .73$ [.71; .74] ($k = 4$) $\alpha_{120} = .76$ [.75; 77] ($k = 19$)	$p = .178$	$p = .188$
	Vocation-oriented	$p = .639$	$p = .451$	$p = .116$	$p = .806$	$p = .762$	$p = .559$
	Ambivalent	$p = .228$	$p = .127$	$p = .822$	$p = .024$ $R^2 = 10.94\%$ $\alpha_{60} = .61$ [.56; .65] ($k = 4$) $\alpha_{100} = .69$ [.67; .70] ($k = 7$) $\alpha_{120} = .74$ [.73; 75] ($k = 19$)	$p = .726$	$p = .406$

Note: Highlighted in grey, analyses where a significant ($p < .05$) effect of the moderator variable was found.

α_{health} : alpha coefficient among students of health care sector. α_{social} : alpha coefficient among students of social sciences. α_{misc} : alpha coefficient among higher education students of different subjects. α_{60} : alpha coefficient among studies that used 60-item ILS. α_{100} : alpha coefficient among studies that used 100-item ILS. α_{120} : alpha coefficient among studies that used 120-item ILS. More data (such as I^2 for each subgroup and all results for non-significant moderators) is available in open materials (Ciraso-Calí et al., 2025)

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