Revista Científica Multidisciplinar G-ner@ndo ISSN: 2806-5905

Psychometric properties of learning style instruments: a systematic review

Propiedades psicométricas de los instrumentos de estilo de aprendizaje: una revisión sistemática

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DIMENSIÓN CIENTÍFICA

Enero - junio, V°7 - N°1; 2026

Recibido: 03-06-2026
Aceptado: 04-06-2026
Publicado: 06-06-2026

PAIS

- Ecuador, Portoviejo
- Ecuador, Jipijapa
- Ecuador, Paján
- Ecuador, Jipijapa

INSTITUCION

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FORMATO DE CITA APA.

Durán, M., Jijón, L., Borbor, L., & Durán, Y. (2026). Psychometric properties of learning style instruments: a systematic review. Revista G-ner@ndo, V°7 (N°1). Pág. 6376 – 6397.

Abstract

The most widely used learning style instruments in higher education—KLSI (Kolb), ILS (Felder–Silverman), CHAEA (Honey–Alonso), and VARK—enjoy sustained popularity but show heterogeneous psychometric evidence. The objective of this research is to identify the reliability (α / ω /test–retest), internal structure (AFE/AFC/SEM), and validity (content, convergent/discriminant) of the KLSI, ILS (Felder-Silverman), CHAEA, and VARK instruments in university populations through a systematic review of the literature. An exploratory systematic review was conducted based on Fernández-Sánchez et al. The psychometric properties of KLSI, ILS, CHAEA, and VARK in higher education were investigated to determine which instrument shows the best metrics. Studies (2010-2025) were searched for in Scopus, Scielo , MedLine, Dialnet , and Google Scholar. Rayyan was used, 46 articles were reviewed, and 15 were selected. reliability (α): KLSI (0.82) ≥ CHAEA (0.78) ≈ VARK (0.78) and ILS (with weak subscales 0.66). Structure (AFE/AFC): KLSI: adequate with adjustments; CHAEA favorable; CHAEA-36: unstable; ILS: fragmentation in subscales; VARK: CFA/Rasch support, but with nuances. Test–retest: best documented in ILS (medicine) and KLSI; less so in recent CHAEA/VARK. KLSI has the strongest psychometric support, although it requires AFC and language invariance. CHAEA has variable evidence and its abbreviated versions require structural revision. ILS continues to be used, but its structure is unstable and needs refinement with AFC. VARK has partial support and requires current confirmatory validations.

Keywords: Higher education, Reliability of learning style instruments, psychometric properties, validity.

Resumen

Los instrumentos de evaluación de estilos de aprendizaje más utilizados en la educación superior —KLSI (Kolb), ILS (Felder–Silverman), CHAEA (Honey–Alonso) y VARK— gozan de una popularidad constante, pero presentan resultados psicométricos dispares. El objetivo de esta investigación es identificar la fiabilidad (α/ω/test-retest), la estructura interna (AFE/AFC/SEM) y la validez (de contenido, convergente/discriminante) de los instrumentos KLSI, ILS (Felder-Silverman), CHAEA y VARK en poblaciones universitarias mediante una revisión sistemática de la literatura. Se llevó a cabo una revisión sistemática exploratoria basada en Fernández-Sánchez et al. Se investigaron las propiedades psicométricas de KLSI, ILS, CHAEA y VARK en la educación superior para determinar qué instrumento presenta las mejores métricas. Se realizaron búsquedas de estudios (2010-2025) en Scopus, Scielo, MedLine, Dialnet y Google Scholar. Se utilizó Rayyan, se revisaron 46 artículos y se seleccionaron 15. fiabilidad (α): KLSI (0,82) ≥ CHAEA (0,78) ≈ VARK (0,78) e ILS (con subescalas débiles 0,66). Estructura (AFE/AFC): KLSI: adecuada con ajustes; CHAEA: favorable; CHAEA-36: inestable; ILS: fragmentación en las subescalas; VARK: apoyo del AFC/Rasch, pero con matices. Test-retest: mejor documentado en ILS (medicina) y KLSI; menos en los recientes CHAEA/VARK. El KLSI cuenta con el mayor respaldo psicométrico, aunque requiere un análisis de factor confirmatorio (AFC) y la invarianza lingüística. El CHAEA presenta un nivel de evidencia variable y sus versiones abreviadas requieren una revisión estructural. El ILS sigue utilizándose, pero su estructura es inestable y necesita un perfeccionamiento mediante un análisis de factor confirmatorio (AFC). El VARK cuenta con un respaldo parcial y requiere validaciones confirmatorias actuales.

Palabras clave: Educación superior, fiabilidad de los instrumentos de estilos de aprendizaje, propiedades psicométricas, validez.

Introducción

It is important to recognize the growing evidence that questions the effectiveness and validity of theories about learning styles. If these theories suggest that adapting instruction to individual learning preferences can improve results, empirical studies have shown limited support for this approach (Pashler et al., 2008).

Reliability according to Nunnally (1991) is a term that refers to notions of stability, precision and predictability in medicine. This is the accuracy with which an instrument measures what you want to measure and implies the relative absence of measurement errors while Kerlinger and Lee (2001) ensure that validity is the most important requirement of a test, because it refers to that the instrument is measuring what you want to measure exhaustively (Carlos Saúl Juárez Lugo, 2014).

Kolb provided a detailed theory of experiential learning and developed the LSI/KLSI to evaluate four skills and styles. Although his contribution consolidated the notion of individual differences, the main criticism points to the measurement method and the psychometric solidity of the inventory (Pickworth & Schoeman, 2000). The Felder-Silverman learning styles model (FSLSM 1988; revision 2002) defines four dimensions: active/reflective, sensorial/intuitive, visual/verbal and sequential/global. From there, the ILS estimates student preference trends and its current version is described as reliable and valid for this descriptive purpose (Wang & Mendori, 2015). In the CHAEA, the theoretical, reflective, active and pragmatic styles are not supported unequivocally in the original exploratory factorial analysis: more groupings of expectations and the solution in four factors emerged, making it difficult to replicate in several studies (Villarreal-Fernández, 2023).

The measurement of “learning styles” continues to be popular in higher education, but its psychometric basis varies between instruments and contexts. Recent versions (e.g. , KLSI 4.0) declare improvements in validity and reliability; other scales (e.g., CHAEA) show results found in the factorial structure; ILS and VARK are used a lot, but contemporary evidence of construct validity and invariance in universities is patchy.

Distinguishing between the pedagogical debate and the quality of measurement is crucial: that the hypothesis of the pairing lacks support does not imply, in itself, that all instruments are psychometrically invalidated. Therefore, a systematic review centered on psychometric properties — reliability, internal structure, construct validity, measurement invariance, measurement error, etc. — is a specific and necessary contribution to guide the responsible use of these tools. The field has standards and guidelines to evaluate instruments: the Standards for Educational and Psychological Testing (AERA/APA/NCME), the COSMIN guide for measurement property reviews, and PRISMA 2020 recommendations to inform systematic reviews. Adapting these milestones to educational instruments such as EA improves the transparency and solidity of conclusions (American Educational Research Association et al., 2014).

This research work is part of the doctoral project in Biomedical Sciences entitled “Changes in learning styles according to the level studied during the basic cycle in medical students”, developed at the Instituto Universitario Italiano de Rosario, and is articulated with the institutional project of the Universidad San Gregorio de Portoviejo called “Didactic strategies for the development of skills among students in the Medicine career at the Universidad San Gregorio de Portoviejo”.

The objective of the investigation is to identify the psychometric properties of learning style measurement instruments (KLSI, ILS, CHAEA and VARK) in university populations,

through a systematic literature review. Its identification is not just a methodological question, but an indispensable requirement to ensure that its use is informed, rigorous and useful.

Methods

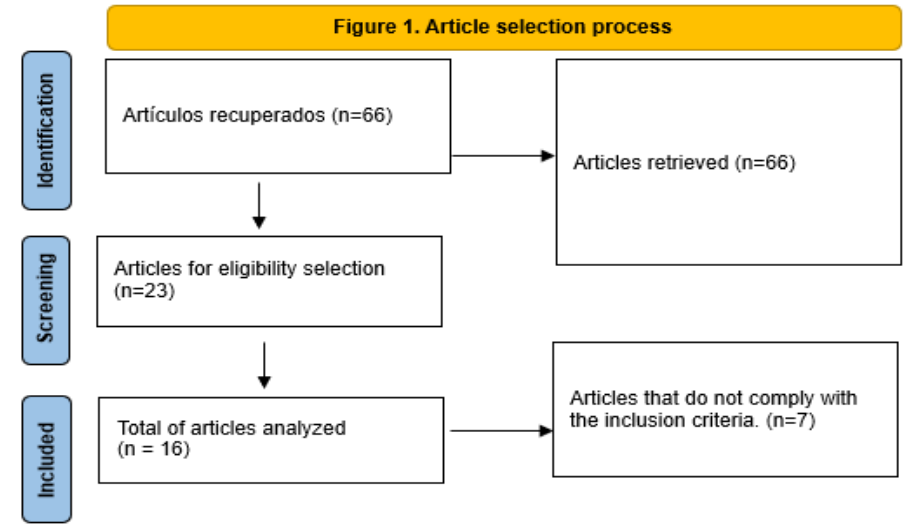
The exploratory systematic review methodology was employed, from the perspective of Fernández – Sánchez and others (Fernández-Sánchez et al., 2020), which means that these " can be carried out to give answers to a series of research questions", with the aim of "summarizing and disseminating the existing evidence". In order to synthesize information about measurement instruments for learning styles, we have raised the following questions: What are the psychometric properties reported by KLSI/ILS/CHAEA/VARK in higher education? Which learning styles instrument shows the best metrics?

An exhaustive systematic search was carried out using the databases Scopus, Scielo, MedLine (PubMed), Dialnet, Google Scholar , with a range of time from 2010 to October 2025. A search strategy was developed that included relevant terms in both Spanish and English. MeSH terms , and Boolean operators with terms such as OR and AND were used, a search strategy was developed that included terms relevant to the topic, in Spanish such as: ("KLSI" OR "Kolb Style Learning Inventory " OR "Learning Style Inventory " OR "KLSI 3.0" OR "KLSI 3.1" OR " Index of Learning Styles " OR "ILS" OR "Felder-Silverman" OR "CHAEA" OR " Honey -Alonso" OR "VARK") AND (psychometr * OR reliable * OR reliable * OR "Cronbach's alpha" OR "McDonald's omega" OR validity OR "factorial analysis" OR "confirmatory factorial analysis" OR "exploratory factorial analysis" OR invarianz * OR Rasch OR "test- retest " OR reproducible *) AND (students OR universities * OR education OR "health sciences" OR medicine OR nursing) AND (2010:2025)

In language English : ("KLSI" OR "Kolb Learning Style Inventory" OR "Learning Style Inventory" OR "KLSI 3.0" OR "KLSI 3.1" OR "Index of Learning Styles" OR "ILS" OR "Felder-

Silverman" OR "CHAEA" OR "Honey-Alonso" OR "VARK") AND (psychometric* OR reliability OR "internal consistency" OR "Cronbach*" OR "McDonald* omega" OR validity OR "factor analysis" OR "confirmatory factor analysis" OR "exploratory factor analysis" OR "measurement invariance" OR Rasch OR IRT OR "test-retest" OR reproducib *) AND (students OR undergraduate* OR medical OR nursing OR education) AND (2010:2025). The results obtained from the reference search were loaded into the Rayyan software (Ouzzani et al., 2016). To develop this investigation, 66 articles were consulted. For the selection process, the author independently created the titles and abstracts obtained through the search according to the inclusion criteria. The established criteria were: (1) the study must be published in a peer-reviewed journal, (2) in the least one of the following studies: psychometric validation / evaluation of the KLSI , ILS , CHAEA , VARK instruments used in Higher Education, and (3) types of documents: validation / evaluation studies psychometric (reliability, AFE/AFC, SEM, Rasch /IRT, invariance, convergent/discriminant/criterion validity), technical manuals or recent revisions of psychometric data. Studies at primary or secondary educational levels and work not linked to the pedagogical or educational scope were excluded. Finally, a total of 15 bibliographic sources in English and Spanish were selected.

Figure 1. *shows a flow diagram of the screening and selection process*.



Source: prepared by the authors.

Ethical considerations.

The investigation complies with ethical agreements, respects the rights of the authors, protects intellectual property through the citation with Vancouver Standards of the research articles used.

Data Collection

A standardized data collection form (Excel 2010 - Microsoft) was designed to collect data from included studies independently. After creating references according to the inclusion criteria considering title and summary, the full texts will be retrieved.

Data analysis and synthesis

Data from selected studies were analyzed through critical and systematic reading, extracting relevant information such as the main Learning Styles measurement instruments with their psychometric validation/evaluation.

Results

Psychometric evidence of learning style instruments (ILS, VARK, KLSI and CHAEA) is presented in university populations in several countries. The author, year, instrument, context, musical size and main hallmarks (reliability, structure, validity and stability) are presented.

Table 1. *Reported psychometric properties of learning style measurement instruments in studies published between 2010 and 2025.*

Author(s)	Year	Title	Instrument	Population (level / country)	n	Reported psychometric properties
Al- Azawei , A.; Parslow , P.; Lundqvist , K. (Al-Azawei et al., 2015)	2015	A psychometric analysis of reliability and validity of the index of learning styles (ILS)	ILS (Felder–Silverman)	Engineering students (university) / United Kingdom–Irak	259	Perception" and "Input" dimensions exhibit moderate levels of internal reliability and appropriate factorial loads, while the "Processing" and "Understanding " dimensions demonstrate low internal consistency and weakness in the loads, which suggests that certain ILS subscales require refinement to improve their psychometric solidity in this cultural context.
Litzinger , TA; Lee, SH; Wise, J.C.; Felder, R. M. (Litzinger et al., 2007)	2013	A Psychometric Study of the Index of Learning Styles©	ILS (Felder–Silverman)	Engineering students (university) / EE. UU.	710	The internal consistency of the four scales varied between 0.55 and 0.77 Cronbach's alpha. An exploratory factor analysis was carried out which showed that the instrument is not strictly one-dimensional, as three of the four scales were divided into multiple factors coherent with the original theoretical components, which provides evidence of construct validity. Altogether, the findings confirm that the ILS presents adequate evidence of validity and reliability, and that its theoretical structure is empirically supported despite the multidimensional complexity of some subscales.
Hosford, C.C.; Siders, WA (Hosford & Siders, 2010)	2010	Felder-Silverman Index of Learning Styles: internal consistency, temporal stability, and factor structure	ILS (Felder–Silverman)	Medical students (university) / EE. UU.	136	Internal consistency, stability test– retest (≈.68–.86 per scale) and examination of the structure in a medical population.
Milk , WL; Svinicki , M.; Shi, Y. (*Validez y confiabilidad del*	2010	Validity and Reliability of the VARK® Questionnaire	VARK (official summary)	Technical summary (multiple studies)	hundreds of students	multitrait-multimethod models , confirming that the four modalities (Visual, Aural, Read / Write and Kinesthetic) function as differentiated and consistent dimensions. The reliability coefficients obtained were high for three subscales (0.85; 0.84; 0.82) and adequate for Kinesthetic (0.77), and it was warned that Cronbach's alpha could

Author(s)	Year	Title	Instrument	Population (level / country)	n	Reported psychometric properties
cuestionario VARK®, 2020)						underestimate the reliability of the instrument due to its multiresponse nature. The study concludes that VARK is valid and reliable for evaluating learning preferences in university students, with good internal consistency and factorial support.
Platsidou , M.; Metallidou , P. (Platsidou & Metallidou, 2008)	2015	Validity and Reliability Issues of Two Learning Style Inventories in a Greek Sample	VARK (Rasch)	Adults/students/ United Kingdom	107	Rasch analysis by subscales: acceptable global adjustment; 3 supported subscales; 1 item with problematic fit.
Wong, J. S. W.; Chin, KCW (Julia S. W. Wong & Kenny C. W. Chin, 2018)	2018	Reliability of the VARK Questionnaire in Chinese Nursing Undergraduates	VARK v7.8 (Chinese)	University students / China	2230	Structural Ecuation Models have a four-factor structure with 25 items (different from the original model), adapted to the “Investigator, Practical, Experimenter and Active” styles. The fit indices of the confirmatory model were adequate, which supports the construct validity, and the instrument is considered valid and reliable for this context. Although the article does not explicitly detail the Cronbach's alpha coefficients for each factor, it is stated that the psychometric properties are acceptable according to psychometric theory and practice, validating their use in Colombian university students.
Villarreal Fernández, JE (Fernández, 2023)	2021	CHAEA: Psychometric properties in Colombian university students	CHAEA-36 (abbreviated version)	Universities / (studies in LATAM)	2,230 students for exploratory factor analysis and 661 for confirmatory	Mixed results in structure (ESEM/AFC) and convergent/discriminant validity; Caution and adjustments are recommended.
Juárez Lugo, CS (Carlos Saúl Juárez Lugo, s. f.)	2014	Honey questionnaire - Learning styles assessment (CHAEA) in a Mexican sample	CHAEA	University students (first admission) / Mexico	678	Acceptable internal consistency, temporal stability, factorial structure
Luis Alberto Cardozo et al.,	2021	Psychometric properties of the “CHAEA-36” learning	CHAEA-36	University students	573 subjects in total, divided into two	Evidence of latent structure, some limitations

Author(s)	Year	Title	Instrument	Population (level / country)	n	Reported psychometric properties
(Cardozo et al., 2021)		styles questionnaire for students.			independent samples (one for content/apparent validation and the other for confirmatory validation).	
Kolb, AY; Kolb, DA (Kolb & Kolb, s. f.)	2013	The Kolb Learning Style Inventory 4.0	KLSI 4.0 (technical manual)	Mixed normative exhibition (includes university students) / International	10,423	Internal consistency by scale: EC=.83; RO=.83; AC=.83; AE=.76. Summary internal/external validity; 9 styles and 'flexibility'.
Kolb, AY; Kolb, DA (Kolb, s. f.)	2013	KLSI 3.1 & 3.2 – Technical Specifications	KLSI 3.1–3.2 (specifications)	Online users (including university students) / International	5,023	Reliability by scale (CE=.77; RO=.81; AC=.84; AE=.80), test– retest and validity scores.
Churica et al. (Nhadumbuque et al., 2024)	2024	Validation of Felder -Solomon Index of Learning Styles in Mozambique	ILS (Felder–Silverman)	University students / Mozambique		Evidence of content validity is reported through expert review and semantic adjustment of items, as well as construct validity through analysis of the structure of the instrument and coherence between the dimensions proposed by the Felder and Silverman model. The results indicate acceptable internal consistency, with alpha coefficients within expected ranges for validation studies in higher education, which supports the stability of the subscales.
Manolis , C.; Burns, DJ; Assudani , R.; Chinta, R. (Manolis et al., 2013)	2013	Assessing experiential learning styles: A methodological reconstruction and validation of the Kolb	KLSI	Postgraduate students (engineering, computer science) and quantitative university	147	The study reformulates the original KLSI by transforming its typology scales into continuous scores, and proposes a revised version that demonstrates good internal consistency, with Cronbach coefficients of 0.84, 0.85 and 0.79 for the three factors identified in Study 1, and solid factorial loads to perform exploratory and

Author(s)	Year	Title	Instrument	Population (level / country)	n	Reported psychometric properties
		Learning Style Inventory		students / EE. UU.		confirmatory factor analysis; The factors showed moderate correlations between them, supporting their differentiation but also interrelationship. Although extensive details about external validity are not provided in this article, the methodological approach suggests that the reconstructed version allows for a better intra-individual comparison of styles, which provides structural and construct validity of the revised instrument.
Rashvand Semiyari , S. et al. (Rashvand Semiyari & Azad, 2022)	2022	Development and Validation of KOLB 4.0 Learning Style Questionnaire	KLSI 4.0	University students		Multiple validation procedures were employed: content and face validity through expert judgments and pilot interviews, and constructive validity through confirmatory factor analysis (CFA) with structural modeling. The original model of new factors did not adjust well (due to high correlations between factors), so it merged three highly correlated pairs and reduced the model to six factors, with 30 final items. The model adjustment was acceptable: χ^2/ df = 4.05; GFI = 0.90; RMSEA = 0.060; SRMR = 0.07; PGFI = 0.45. For internal reliability (internal validity), Cronbach's alpha values for the six factors will be reported: Analyzing / Thinking α = 0.83; Experiencing / Acting α = 0.72; Creating α = 0.76; Reflecting α = 0.77; Initiating / Deciding α = 0.80; Balancing α = 0.74.
Agustín Freiberg-Hoffmann, Facundo Abal, Mercedes Fernández-Liporace (Freiberg-Hoffmann et al., 2020)	2020	Honey - Alonso Learning Styles Survey : New psychometric evidence in the Argentine population	CHAEA	University students from Buenos Aires		The study demonstrated a valid factorial structure through confirmatory analysis (CFI = 0.932; NFI = 0.915; NNFI = 0.924; RMSEA = 0.066), as well as metric invariance between faculties, which confirms the stability of the model in different subgroups. The internal consistency of the dimensions was calculated as acceptable, online with previous investigations, and the temporal stability was supported by a test– retest without significant differences between measurements.

Author(s)	Year	Title	Instrument	Population (level / country)	n	Reported psychometric properties
						Furthermore, if concurrent validity is evident, these styles can relate positively to the deep learning approach and negatively to the superficial one (except for the adapter style), which supports the instrument's capacity to associate with relevant external variables in the educational context.
Fernando Maureira Cid, et al., (Cid et al., 2018)	2018	Psychometric properties of the Kolb learning styles inventory and the Felder-Silverman questionnaire in physical education students in Santiago de Chile	ILS (Felder Silverman) / KLSI (Kolb)	Physical Education university students / Chile	141	Validity: adequate indices for the 4 subscales. Reliability: Cronbach's alphas due to lower acceptable levels in the subscales. It is recommended to replicate with other universities.

Table 1 shows heterogeneous evidence among university students from various countries for ILS, VARK, KLSI and CHAEA. ILS presents moderate reliability and multifactorial structure; It is more stable in Medicine, but requires refinement in Arab contexts and in Chile. VARK obtains good adjustment with MTMM and Rasch , acceptable reliability and item adjustments; In China, a 4-factor/25-item solution emerges. CHAEA/CHAEA-36 reports acceptable consistency, concurrent validity and invariance in Argentina, restructuring of 25 items in Colombia and suggested reduction in Mexico. KLSI offers high alphas in manuals, even though independent validations provide reconceptualizations

Table 2. *Comparison of psychometric properties of learning style instruments used by countries.*

COUNTRY	validated instrument	Cronbach's Alpha / Reliability	Reported Validity (Internal / External)	Psychometric Conclusion
ARGENTINA	CHAEA	Acceptable consistency (does not detail α per subscale)	**Construct** (CFA: CFI≈0.93; RMSEA≈0.066); **invariance** between faculties; **concurrent** (R-SPQ-2F)	Valid, stable and coherent structure; fit for ES.
COLOMBIA	CHAEA-36	Acceptable (in 4-factor/25-item model)	**Construct** (SEM/AFC)	Valid and reliable in university students; version adjusted to 25 items.
MEXICO	CHAEA	Acceptable by subscale	**Construct** (EFA), **test –retest**	Proper use; I suggest tuning some items.
MOZAMBIQUE	ILS	Acceptable by subscales (without figures)	**Content** (cultural adaptation), **construct**	Valid adaptation to the context; useful for local preferences.
UNITED KINGDOM/IRAK (ARABIC MUSEUM)	ILS	Mixed: moderated in Perception /Input; low in Processing/ Understanding	**Construct** (AFE/CFA)	Require improvements in two dimensions; partial evidence.
USA	ILS	0.55–0.77 second scale; Likert version ↑ reliability	**Construct** (EFA), **test –retest**	Adequate evidence; not strictly one-dimensional; Likert improves α.

COUNTRY	validated instrument	Cronbach's Alpha / Reliability	Reported Validity (Internal / External)	Psychometric Conclusion
CHINA (HK)	VARK (v7.8)	V=0.73, A=0.79, R/W=0.84, K=0.69	**Constructo** (MTMM-CFA; CTCU)	Reliable; weaker kinesthetic; good model fit.
USA	VARK (official synthesis + Leite et al.)	V≈0.85, A≈0.82, R/W≈0.84, K≈0.77 (CFA estimate)	**Constructo** (CFA/MTMM)	Good global metrics; CFA-based α > classical alpha.
IRAN	KOLB 4.0 (66→30 items)	α by factor: 0.83; 0.72; 0.76; 0.77; 0.80; 0.74	**Construct** (CFA/SEM); **content**	Final 6-factor model with good adjustment; reliable.
USA	KOLB (reconstruction)	0.85; 0.84; 0.79 (three factors)	**Construct** (EFA/CFA)	Version remains more parsimonious; improved reliability/structure.
Chile	KLSI (Kolb)	Subscales (α): Concrete Experience .223 ; Reflective Observation .410 ; Abstract Conceptualization .295 ; Active Experimentation .418 .	Exploratory factor analysis (EFA) by subscale with loadings >.60 and explained variance ≈48–61%. Ej.: Conceptualización Abstracta KMO=.511 , Bartlett χ^2=24.76, p=.049.	Although the AFE has an interpretable structure , the reliability is low in all subscales (α<.70), which is why it does not reach the standard for decisions by scale in this population; Additional studies are required and revision/adaptation is possible
CHILE	ILS (Felder Silverman)	Subscales (α): Active–Reflective .475 ; Sensitive–Intuitive .325 ; Visual–Verbal .557 ; Sequential–Global .289 .	AFE by subscale with loadings ≥.37–.78 and explained variance ≈50–60%. Ej.: Visual–Verbal KMO=.633 , Bartlett χ^2=119.98, p<.001; Sensitive–Intuitive KMO=.504 , Bartlett χ^2=105.19, p<.001.	Internal validity (AFE) is acceptable at an exploratory level, but internal consistency is insufficient in all subscales (α<.60 , several <.50). Not recommended for fine dimension decisions in this sample; convenient local validation with AFC and possible item purification .

Source: prepared by the authors.

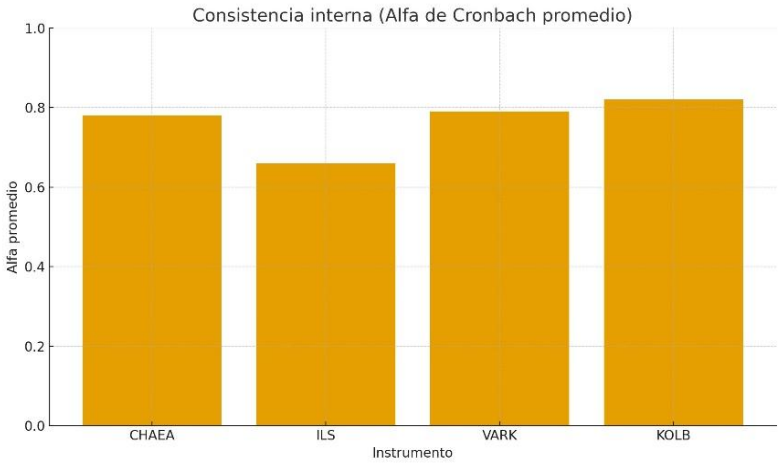
The best global metrics show that KOLB (Iran, EE. UU.) and CHAEA (Argentina, Colombia) show CFA/SEM solids and high/acceptable with large samples (833; 2,230+661; 1,342). In relation to the context of successful cultural adaptation: ILS in Mozambique and VARK in China demonstrate construct validity and acceptable consistency; However, ILS retains the weakest dimensions and VARK shows a somewhat smaller K subscale.

Table 3. *Internal psychometric reliability in revised instruments*

Instrument	Consistency	Validity	Statistical rigor	Necessary adjustments
CHAEA	High	Strong	High	Minimums
KOLB	High	Strong	High	Partial
VARK	Medium-High	Average	Medium-High	Moderate
ILS	Average	Average	Average	Necessary

Source: prepared by the authors.

Figure 2. *Comparison of internal consistency (medium Cronbach's alpha).*.



Source: prepared by the authors.

The figure 2 allows us to see that the KOLB instrument presents greater internal psychometric reliability in the reviewed studies.

Discussion

The balance of available evidence suggests that learning style instruments present mixed and context-dependent psychometric parameters, with occasional advances in recent respecifications and validations. Within the scope of the Felder– Soloman model , classical and recent psychometric analyzes coincide in that the internal consistency and factorial structure of the Index of Learning Styles (ILS) are, to say the least, heterogeneous. In engineering, Litzinger , Lee, Wise and Felder (2013), reported moderate alphas and

difficulties to maintain a clean factorial structure, which highlights the need to interpret the ILS as a measure of preferences and not of stable high-precision characteristics.

Convergently, among medical students, Hosford and Siders (2010), found acceptable temporal stability and a consistent structure in the design of the instrument, but with moderate reliability—sufficient for formative uses, not for high-impact decisions.

When considering adaptations and applications outside the Anglo-Sajón scope, the hallmarks tend to emphasize the cultural sensitivity of the ILS. For example, in a study with physical education students in Chile, Maureira Cid and colleagues (2018), reported adequate validity indices for both Kolb and Felder–Silverman subscales, even with alpha coefficients below commonly accepted levels in all subscales, which encourages caution in their diagnostic use individual. In a complementary way, the analysis by Al- Azawei , Parslow and Lundqvist (2015) — known in the ILS literature — also addresses the need for revisions and additional reliability/validity checks when transferring the instrument to other contexts.

In Kolb's field, it shows an important methodological evolution. The KLSI 4.0 by Kolb and Kolb (2013) consolidates improvements in theory, standards and psychometric reporting, and documents efforts to strengthen construct validity and the interpretation of learning profiles as preferred typologies rather than as rigid categories.

At the same time, methodological reconstructions such as that of Manolis , Burns, Assudani and Chinta (2013) migrate from a categorical typification to continuous measures of style, with gains in sensitivity and factorial adjustment, which offers a way to overcome problems of dichotomous classification and improve the structural validity of the experiential approach.

In Spanish, CHAEA (Honey -Alonso) displays a particularly dynamic panorama. In Mexico, Juárez Lugo (2) reported acceptable internal consistency, adequate temporal stability and a structure with variations explained by reasonable dimensions, but suggested reducing items to optimize the instrument.

In Argentina, Freiberg-Hoffmann, Abal and Fernández- Liporace (2020) provided confirmatory evidence (model adjustment and metric invariance) with acceptable reliability and coherent concurrent relationships with learning approaches, reaffirming the usefulness of CHAEA for contextualized pedagogical research and feedback.

In Colombia, Villarreal Fernández (2021) provided new psychometric properties of the CHAEA in the university population, reinforcing the relevance of adapting and revalidating the instrument according to the population and its intended use.

Furthermore, the development of the CHAEA-36 (2021) form has put on the table the reduction of items and the evaluation of convergent/discriminant validity , with results that advise caution and further studies before adopting abbreviated versions as universal standards.

Regarding VARK , VARK- Learn 's own technical website summarizes evidence of validity and reliability based on MTMM-CFA models (2010), with appropriate estimates by subscale, but warns about potential problems in writing and the scoring algorithm that require investigative caution.

Regarding recent empirical data, Wong and Chin (2018) evaluated the reliability of VARK in Chinese nursing students and obtained alphas between 0.69 and 0.84, reinforcing the idea that the instrument can be useful in educational contexts to explore sensory preferences, without automatically enabling it as a robust predictor of performance.

Altogether, these evidences converge on two key recommendations for practice and research: (1) use learning style inventories as tools for self-reflection and pedagogical dialogue , not as high-impact tests ; and (2) apply any application to local psychometric verification (structure, reliability, invariance and external validity) and, when possible, prefer re-specified or abbreviated versions with empirical support in the objective population (e.g., KLSI 4.0; CHAEA with confirmatory analysis; continuous Kolb reconstructions). This guidance, supported by the aforementioned studies, allows us to take advantage of its formative value and, at the same time, avoid deterministic inferences or educational decisions that exceed the precision that these instruments offer today.

Conclusion

Learning style instruments demonstrate heterogeneous psychometric evidence: KLSI presents the most solid psychometric support, even though it requires AFC and invariance across languages. CHAEA has variable evidence and its abbreviated versions demanding structural revision. ILS continues to be used, but its structure is unstable and requires refinement with AFC. VARK accounts with partial support and requires current confirmatory validations. These acceptable internal consistencies in some subscales, unstable factorial structures between versions and contexts, and irregular temporal stability lead to the fact that its use must be formative and reflective, in addition, before comparing groups or linking points to performance, local validation is required: confirm structure (AFE/CFA), estimate reliability based on models, evaluate invariance and quantify measurement error.

Funding: There was no funding.

Declaration of conflict of interest: The authors declare that they have no conflict of interest.

Author contributions: Conceptualización: MDD, YEDP, NSRL, LFJC; Curación de datos: MDD, YEDP, NSRL, LFJC; Análisis formal: MDD, YEDP, NSRL, LFJC; Adquisición de fondos: MDD, YEDP, NSRL, LFJC; Investigación: MDD, YEDP, NSRL, LFJC; Metodología: MDD, YEDP, NSRL, LFJC. Administración del proyecto: MDD, YEDP, NSRL, LFJC; Recursos: MDD, YEDP, NSRL, LFJC. Software: MDD, YEDP, NSRL, LFJC; Supervisión: MDD, YEDP, NSRL, LFJC; Validación: MDD, YEDP, NSRL, LFJC; Visualización: MDD, YEDP, NSRL, LFJC; Redacción – borrador original: MDD, YEDP, NSRL, LFJC; Redacción – revisión y edición: MDD, YEDP, NSRL, LFJC.

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