

Design and validation of an instrument for measuring research skills in Early Childhood Education teachers

Marianella Alicia Suárez Pizzarello ¹, Eduar Antonio Rodríguez Flores ², Jennifer Ximena Vega Fajardo ³, Paula Andrea Saavedra Parra ⁴, Fredy Giovanni Fernández Gómez ⁵, Edgardo Javier Ramos Caballero ⁶

¹Research and Innovation Department, Autonomous University of Peru, Lima, Peru

ORCID: <https://orcid.org/0000-0002-2793-2268>,

Email: marianella.suarez@autonoma.pe

²Research and Innovation Department, Autonomous University of Peru, Lima, Peru

ORCID: <https://orcid.org/0000-0003-0807-6686>

³Corporación Universitaria Adventista-UNAC, Medellín, Colombia

ORCID: <https://orcid.org/0000-0001-6733-891X>

Email: jvega@unac.edu.co

⁴Corporación Universitaria Adventista-UNAC, Medellín, Colombia

ORCID: <https://orcid.org/0000-0003-4813-6583>

Email: svargas@unac.edu.co

⁵Corporación Universitaria Adventista-UNAC, Medellín, Colombia

ORCID: <https://orcid.org/0009-0001-3042-3528>

Email: psaavedra@unac.edu.co

⁶Corporación Universitaria Adventista-UNAC, Medellín, Colombia

ORCID: <https://orcid.org/0000-0001-8545-5503>

Email: ejramos@unac.edu.co

Abstract: The aim of this study was to design and psychometrically validate an instrument to measure research skills in Early Childhood Education teachers in Colombia. An instrumental quantitative design was used. Content validity was estimated through the judgment of four experts using Aiken's V coefficient, and construct validity was analyzed through an exploratory factor analysis (EFA) using principal components with Varimax rotation. The sample consisted of 342 early childhood education teachers from public and private institutions in urban and rural areas of Colombia. The final instrument, named HIDEI (Research Skills in Early Childhood Education Teachers), comprised 26 items distributed across five dimensions: Exploratory, Cognitive, Methodological, Communicative, and Cooperative. The results showed an overall content validity of 0.70 and adequate internal consistency indices: Cronbach's alpha was 0.924 overall, with per-dimension values ranging from 0.713 to 0.861. The factor structure showed a KMO index of 0.917 and a significant Bartlett's test ($p < .001$), confirming data adequacy for EFA. The five-factor solution satisfactorily explained the theoretical construct. In conclusion, the HIDEI instrument demonstrates adequate psychometric properties for assessing research skills in early childhood education teachers in the Colombian context..

Keywords: *pedagogical skill, applied research, early childhood education, measurement, psychometrics, research skills, instrument validation*

Introduction

Educational research is a fundamental pillar in the development of quality education systems. Within the framework of early childhood education, teachers not only fulfill a formative role, but are also increasingly required to demonstrate an active commitment to the production and application of scientific knowledge in their pedagogical practices (Pozo et al., 2023). However, the specialized literature shows that research skills in this teaching sector are rarely measured with specific, validated, and contextually relevant instruments.

Research skills can be defined as the set of cognitive, methodological, and communicative abilities that allow teachers to identify problems within the educational context, formulate research questions, search for and analyze information, apply systematic methods, and share results with the academic and educational community (Hernández et al., 2021; Ríos et al., 2023). Their development in early childhood education teachers is especially relevant given that these professionals work with populations in the early stages of development, where the capacity for observation, exploration, and evidence-based pedagogical adaptation is crucial for learning.

Despite the existence of instruments to measure research competencies in primary and secondary school teachers (Hernández et al., 2021; Avendaño et al., 2021) and in the university setting (Ríos et al., 2023; Chávez et al., 2023), there are no instruments specifically designed and validated for early childhood education teachers in the Latin American context. This gap represents a significant methodological limitation for the diagnosis and strengthening of research capacities at this educational level.

Given this scenario, the present study aimed to design and psychometrically validate the Research Skills Scale for Early Childhood Education Teachers (HIDEI), through a process that integrates content validity through expert judgment and construct validity through exploratory factor analysis, thus guaranteeing a rigorous, contextually relevant and applicable instrument in the Colombian educational system.

2. Theoretical framework

2.1 Research skills in teachers

Research skills refer to a set of competencies that allow education professionals to systematically address educational realities in order to understand, analyze, and transform them (Pozo et al., 2023). For early childhood educators, these skills take on a unique dimension: they are linked to the ability to observe, explore, and question, which is fostered from the earliest years of life. This transforms the teacher into both a researcher and a facilitator of the scientific spirit in their students. From this perspective, the development of research skills in teachers is not an end in itself, but rather a condition that directly impacts the quality of the learning environments they create (Arévalo et al., 2017).

From a theoretical perspective, the development of research skills in teachers is supported by Vygotsky's sociocultural approach, according to which learning is a socially mediated construction process in which cultural tools—including research methods—play a central role in the appropriation of knowledge (Carrera & Mazzarella, 2001). Along these same lines, Guerra (2020) points out that constructivism, as an epistemological and pedagogical current, posits that knowledge is not passively transmitted but actively constructed from experience and interaction with the environment; a premise that underpins the need for early childhood educators to be able to systematically inquire into their own pedagogical practice in order to transform it. The teacher-researcher not only applies what they know but also generates new knowledge from their own context.

In the specific context of early childhood education, teachers' research skills transcend the academic sphere to directly impact the quality of pedagogical interactions. Arévalo et al. (2017) highlight that critical thinking and research dispositions in early childhood educators in Colombia foster more reflective learning environments that are sensitive to children's needs. Along these lines, the early childhood teacher-researcher is defined not only by their technical ability to apply research methods, but also by their epistemic stance toward reality: an attitude of ongoing inquiry that allows them to question assumptions, identify problems in their daily practice, and seek evidence-based solutions (Medina, 2019). López Balboa et al. (2015) point out that the development of research skills in education and health professionals not only strengthens the quality of the services they provide, but also promotes continuous self-directed learning and the integration of theory and practice. Additionally, Omar and Capdevila (2013) propose that research should be the central element that organizes and evaluates the training component for future teachers, coherently linking the academic, professional, and research aspects. This perspective is reinforced by Álvarez Gómez et al. (2022), who maintain that the development of research skills does not begin at the university level, but is a continuous process that should start from the earliest educational levels, including high school and early childhood education, with the aim of empowering individuals through a reflective, critical, and transformative view of reality.

In accordance with previous theoretical developments, this study adopts a multidimensional model of research skills, which includes five dimensions: (a) Exploratory, referring to the ability to identify problems, search for information in specialized sources, and create learning experiences; (b) Cognitive, focused on formulating questions, classifying information, and solving problems; (c) Methodological, related to designing objectives and hypotheses and using research methods; (d) Communicative, linked to the ability to write, synthesize, and disseminate knowledge; and (e) Cooperative, expressed in participation in collaborative work and research networks. This model integrates the contributions of Hernández et al. (2021), Ríos et al. (2023), and Chávez et al. (2023), and adapts them to the professional profile of early childhood education teachers in the Colombian context. The relevance of adopting a multidimensional approach is supported by studies such as that of Rangel (2019), who showed that the development of research skills in higher education contexts involves cognitive, methodological and communicative processes that cannot be disaggregated without losing their functional coherence, and by Álvarez-Ochoa et al. (2020), who, when characterizing the research skills of university teaching staff, identified differentiated profiles according to the dimension analyzed, which confirms the diagnostic utility of multidimensional models to guide continuing education plans.

2.2 Instruments for measuring research skills

The measurement of research skills in teachers has been addressed in various Latin American contexts using Likert-type scale instruments that seek to operationalize complex constructs into observable and measurable indicators. A recent systematic and bibliometric review on research skills in formal education (Vega & Vargas, 2024), based on 1044 documents from Scopus and Web of Science, found that research skills in formal education are a key area of study. A review of the literature on research in the field of science between 2018 and 2023 showed sustained growth in scientific interest in this area, with a significant peak starting in 2020. The review identified three main categories of research competencies present in the literature: scientific research competencies—which include skills such as formulating questions, information management, methodological design, and communicating results—, personal and transversal competencies—oriented toward autonomy, research ethics, and collaborative work—, and meta-learning competencies—related to reflective, critical, and systemic thinking. Vega and Vargas (2024) conclude that scientific production tends to be concentrated at the university level, and that there is a significant gap in the conceptualization and implementation of

research skills development at early educational levels, including early childhood education. Chávez et al. (2023) developed and validated a research skills scale for university students in the Ecuadorian-Peruvian context, demonstrating that instruments of this type require rigorous content and construct validation processes to ensure their contextual relevance. Their work reports a dimensional structure that includes observation, analysis, synthesis, and scientific communication skills, consistent with the multidimensional theoretical models adopted in recent literature.

In the Colombian context, Avendaño et al. (2021) constructed and validated a scale to measure research competencies in primary and secondary school teachers, obtaining favorable evidence of content validity and internal structure. Meanwhile, Ríos et al. (2023) reported a scale applied to university professors and students in Venezuela, organized into three dimensions with adequate internal consistency indices. Regarding direct measurement of teachers, Baldo et al. (2015) conducted a pioneering study to measure the research competencies of university professors in Venezuela, identifying significant gaps between declared and actually demonstrated competencies, which underscores the importance of having specific, rigorous, and contextually situated instruments. Following a similar methodological approach, Torres et al. (2020) constructed and validated an instrument to characterize teaching competencies at the higher education level, demonstrating that robust psychometric validation processes—which integrate expert judgment, factor analysis, and internal consistency—are a necessary condition for the credibility of this type of tool. Internationally, Torres Delgado and Hernández-Gress (2021) developed a self-assessment model to measure the competencies of research professors at Tecnológico de Monterrey using a sequential mixed-methods design. This model employed performance rubrics structured around four domains: up-to-date and connected, innovative, inspiring, and technology user. Their instrument achieved Cronbach's alpha values above 0.9 on most scales, confirming that faculty self-assessment supported by clear performance criteria is an effective strategy for diagnosing scientific capabilities. This international benchmark is particularly relevant because it demonstrates the methodological viability of multidimensional instruments for evaluating research competencies in specific faculty profiles and explicitly incorporates ethics and technological proficiency as dimensions of the contemporary researcher's profile. These experiences demonstrate a growing interest in developing contextualized instruments for measuring research skills, but they also highlight the lack of instruments specifically designed for early childhood education. Castillo (2011) noted early on that assessing research competencies requires clear conceptual frameworks that distinguish performance levels, an approach that remains relevant as a criterion for instrument design. Medina (2019) emphasizes that teaching strategies aimed at developing research skills in university contexts require monitoring and evaluation tools tailored to the specific characteristics of each educational level, reinforcing the importance of developing specialized instruments for early childhood education. This gap is confirmed by Vega and Vargas (2024), whose systematic review identified that, while research recognizes the possibility of developing research skills from the preschool level—related to observation, formulating questions, experimentation, and data recording—no practical tools were found to assess research progress at this educational level. This double gap—in instruments for early childhood education teachers and in pathways for evaluating research development in early childhood—justifies the design and validation of the HIDEI instrument as a specific, contextualized and methodologically sound contribution to the field of educational measurement in Colombia.

2.3 Fundamentals of instrument validation

test theory and on the standards for psychological and educational assessment proposed by the American Educational Research Association . Research Association (AERA), the American Psychological Association (APA) and the National Council on Measurement in Education (NCME).

According to this framework, validity is conceived as a unitary process that integrates content, construct, and criterion evidence (Messick, 1995).

Content validity is estimated through expert judgment. Aiken's *V* coefficient quantifies the level of agreement among evaluators regarding the pertinence, clarity, coherence, and relevance of each item, with values equal to or greater than 0.70 considered acceptable according to Hernández-Nieto (2011). Construct validity, understood as evidence that the instrument measures the proposed theoretical dimensions, is addressed through exploratory factor analysis (EFA), which identifies the latent structure of the items based on observed covariances (Hair et al., 2019).

3. Method

3.1 Design

This work corresponds to an instrumental study (Montero & León, 2007), quantitative in nature, aimed at the development and psychometric validation of a measurement scale. This type of design is appropriate when the central objective is the construction or adaptation of assessment instruments and the analysis of their metric properties.

3.2 Participants

The sample consisted of 342 early childhood education teachers affiliated with educational institutions in Colombia. 75% of the participants were female ($n = 257$) and 24.9% were male ($n = 85$). Regarding educational level, 68.7% held an undergraduate degree ($n = 235$), 14.3% a specialization ($n = 49$), 16.1% a master's degree, and 0.9% a doctorate ($n = 3$). As for the type of institution, 52.6% worked in the public sector and 47.4% in the private sector; 65.8% in institutions without religious affiliation ($n = 225$) and 34.2% in religious institutions ($n = 117$). Regarding location, 84.5% came from urban areas and 15.5% from rural areas. The sampling was non-probabilistic by convenience, with inclusion criteria that considered being an active teacher at the level of early childhood education (preschool to fifth grade) in Colombia and participating voluntarily.

3.3 Instrument

The HIDEI scale (Research Skills in Early Childhood Education Teachers) was developed specifically for this study. The initial version consisted of 36 items organized into five theoretical dimensions: Exploratory (items 1-6), Cognitive (items 7-12), Methodological (items 13-20), and Communicative and Cooperative (items 21-26). Each item is answered using a five-point Likert scale (1 = Never; 5 = Always). The instrument includes an initial section for sociodemographic data (sex, educational level, type and location of institution, and grade level).

3.4 Validation procedure

The validation process was developed in two sequential phases that allowed the instrument to be refined both in its content and its internal structure.

Phase 1. Content validity through expert judgment. Content evaluation was conducted by a panel of four experts selected for their experience in education, psychometrics, and educational research, as well as their expertise in Colombian and Latin American contexts. The panel consisted of: (a) Expert 1, a research professor at the Peruvian Union University, with training in educational research and experience in developing measurement instruments; (b) Expert 2, a specialist in education and university teaching with extensive experience in Colombian educational contexts; (c) Expert 3, PhD, a researcher with a doctorate in education and experience in educational methodology and measurement; and (d) Expert 4, a professor and researcher in the area of pedagogy and curriculum.

The evaluation was conducted between August and September 2024. Each expert independently assessed all items of the instrument based on four criteria: coherence (item's correspondence with the methodological congruence framework), clarity (absence of confusion or contradiction in the wording), scale (possibility of being answered using the proposed Likert scale), and relevance (item's contribution to achieving the research objectives). The rating scale ranged from 1 (Unacceptable) to 5 (Excellent). Ratings were quantified using Aiken's V coefficient, interpreted according to the criteria of Hernández-Nieto (2011), with an acceptance threshold of 0.70.

Phase 2. Construct validity using EFA. With the refined 26-item version resulting from the expert review process, the instrument's internal structure was verified using exploratory factor analysis (EFA). This method is appropriate in the initial stages of construct validation when there is insufficient prior empirical evidence to specify the number and composition of the factors (Lloret-Segura et al., 2014). Principal component extraction with Varimax rotation and Kaiser normalization was used, applied to the data from the sample of 342 teachers. Before performing the EFA, two fundamental statistical assumptions were verified: the adequacy of the sample using the Kaiser-Meyer-Olkin (KMO) index— for which a value ≥ 0.70 was considered the minimum acceptable value—and the significance of the correlations between items using Bartlett's test of sphericity ($p < 0.05$). For item retention, the criteria of Hair et al. (2019) were applied, who establish a minimum acceptable factor loading of 0.40. The interpretation of the resulting factor structure was based on the five-dimensional theoretical model that guided the construction of the instrument.

3.4.1 Qualitative observations of experts and adjustment decisions

In addition to quantitative assessments, the experts provided qualitative observations that enriched the instrument refinement process and guided decisions regarding the modification, replacement, or elimination of items. These observations were systematized into four thematic categories: wording and grammatical person, suitability of the terms to the measurement scale, coherence with the construct, and suggestions for new items.

Regarding the suitability of the items to the measurement scale, several experts identified that certain items contained constructs that were difficult to operationalize on a frequency scale. Expert 4 observed that terms such as "motivate," "encourage," and expressions like "you find it easy to write" were problematic for placement on a rating scale, and therefore suggested replacing them with verbs of observable and measurable performance. Similarly, Expert 3 noted that the item referring to "creating sensory experiences" could be interpreted as a design skill rather than an observational one, which affected its correspondence with the exploratory dimension.

Regarding coherence with the construct, expert 3 raised a particularly relevant structural observation: the instrument, in its initial version, seemed to simultaneously address two intersecting purposes throughout the items. On the one hand, it measured the research skills of the teacher as an individual; on the other, it explored whether the teacher fostered these same skills in their students. From their perspective, this second approach was beyond the scope of the proposed study. This observation led to a thorough revision of the instrument, focusing it exclusively on measuring the teacher's research abilities and eliminating or reformulating the items that combined both aspects.

Finally, expert 4 proposed the addition of three new items not included in the initial version: one for the methodological dimension related to the use of specialized research software, one for the communicative dimension related to sharing research results with students, and one for the cooperative dimension linked to participation in research groups, networks, or collectives. These suggestions were incorporated into the final version of the instrument as part of the replacement items designed after the Aiken's V refinement process. Taken together, the experts' qualitative observations provide further

evidence of the instrument's content validity and reflect a rigorous, iterative process in its development.

3.5 Data Analysis

Internal consistency analysis was performed using Cronbach's alpha coefficient for both the overall instrument and each dimension individually, following the criteria of Nunnally and Bernstein (1994), who consider values equal to or greater than 0.70 acceptable. All statistical analyses—including the KMO test, Bartlett's test of sphericity, exploratory factor analysis, and reliability analyses—were conducted using IBM SPSS Statistics software, version [specify version]. A significance level of $p < 0.05$ was considered for all inferential statistical tests. Teacher participation was voluntary and anonymous, ensuring the confidentiality of information throughout the data collection process.

4. Results

4.1 Content validity

Following the initial conceptual review process, the instrument was reduced from 36 to 30 items by eliminating 6 items that did not align with the theoretical construct. Subsequently, four experts determined the elimination of 4 additional items for not demonstrating a direct relationship with research skills, the modification of 12 items based on the criteria of coherence, clarity, and relevance, and the retention of 5 items that satisfactorily met the evaluation standards. The 9 items with low Aiken's V values were replaced with new items. The final instrument achieved an overall content validity of 0.70, with individual expert ratings ranging from 0.57 to 0.75, a level interpreted as acceptable according to Hernández-Nieto (2011).

4.2 Internal consistency

The reliability analysis of the final 26-item version revealed high overall internal consistency ($\alpha = 0.924$). At the level of each dimension, the results were equally satisfactory, as shown in Table 1.

Table 1

Reliability statistics by dimensions

Cronbach's alpha	Number of elements	Items	Dimension
,713	6	1-6	Exploratory
,817	6	7-12	Cognitive
,861	8	13-20	Methodological
,717	6	21-26	Communicative and Cooperative
,924	26	1-26	Total

Note. Cronbach's alpha values for all dimensions exceed the minimum acceptable threshold of 0.70 (Nunnally & Bernstein, 1994), being especially robust in the Cognitive and Methodological dimensions.

4.3 Assumptions prior to factor analysis

Before proceeding with the exploratory factor analysis, the required statistical assumptions were verified (Table 2). The KMO index obtained was 0.917, a value categorized as excellent according to Kaiser (1974), indicating that the correlations between items are compact and adequate for factor analysis. Bartlett's test of sphericity was statistically significant ($\chi^2 = 3826.312$; $df = 325$; $p < 0.001$), rejecting the hypothesis that the correlation matrix is an identity matrix and confirming the presence of sufficient correlations between the items.

Table 2

KMO and Bartlett Test

Proof	Statistical	Worth
Kaiser-Meyer -Olkin (KMO)	Sample adequacy measure	,917
Bartlett's sphericity test	Chi-square approx.	3826,312
	gl	325
	Next.	,000

Note. KMO = Kaiser-Meyer- Olkin ; df = degrees of freedom.

4.4 Construct validity: Exploratory Factor Analysis

The principal component analysis (PCA) with Varimax rotation converged in 16 iterations and revealed a five-factor structure consistent with the proposed theoretical model. The factor loadings of all items exceeded the threshold of 0.40 established by Hair et al. (2019). Table 3 presents the rotated component matrix with the final assignment of each item to its corresponding dimension.

Factor 1 (Methodological) comprised 8 items with loadings between 0.465 and 0.741, with items 15 and 16 having the highest factor loadings. Factor 2 (Cognitive) comprised 4 items with loadings ranging from 0.599 to 0.713. Factor 3 (Communicative) included 4 items with loadings between 0.531 and 0.737. Factor 4 (Exploratory) comprised 6 items with loadings between 0.470 and 0.744. Factor 5 (Cooperative) comprised 4 items with loadings between 0.425 and 0.714. Overall, the five factors satisfactorily explained the variance of the construct.

Table 3

Construct validity: Rotated component matrix (EFA)

Item	Methodological	Cognitive	Communicative	Exploratory	Cooperative
15 Item	,741				
16 Item	,690				
18 Item	,599				
Item	,583				

Design and validation of an instrument for
measuring research skills in Early Childhood
Education teachers

Item	Methodological	Cognitive	Communicative	Exploratory	Cooperative
17					
Item 14	,580				
Item 8	,555				
Item 7	,543				
Item 13	,465				
Item 10		,713			
Item 11		,655			
Item 12		,618			
Item 9		,599			
Item 19			,737		
Item 21			,698		
Item 22			,654		
Item 23			,531		
Item 5				,744	
Item 24				,720	
Item 4				,698	
Item 20				,563	

Item	Methodological	Cognitive	Communicative	Exploratory	Cooperative
26				,510	
6				,470	
25					,714
3					,618
2					,425
1					—

Note. Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization. Blank cells indicate loadings < 0.40, suppressed for readability. Inclusion criterion: factor loading ≥ 0.40 (Hair et al., 2019).

5. Discussion

The HIDEI instrument differs from previous studies in the literature in one key structural aspect: its target population. Instruments previously developed in the Latin American context—Hernández et al. (2021) and Baldo et al. (2015) for primary, secondary, and university teachers; Chávez et al. (2023) and Ríos et al. (2023) for university students—share the assumption that research skills develop and are expressed equivalently at any educational level. HIDEI challenges this assumption by positing that early childhood educators operate in a context with particularities that modify the very nature of the construct: they work with children in the early stages of development, in environments where systematic observation, exploration, and pedagogical questioning are not only professional skills but also formative tools that shape the scientific spirit of their students. This dual role—the teacher as researcher and as a facilitator of research attitudes—justifies the development of an ad hoc instrument and explains why items from previous scales could not be directly adapted. The Aiken's V of 0.70 obtained—comparable to that reported by Hernández et al. (2021) and consistent with the criteria of Hernández-Nieto (2011)—thus takes on a more robust meaning: it not only reflects the clarity of the wording of the items, but also the level of agreement of experts on what it means to investigate in and from early childhood education.

The resulting five-factor structure—Exploratory, Cognitive, Methodological, Communicative, and Cooperative—is theoretically coherent and empirically sound, but its interpretation goes beyond mere congruence with the initial model. The fact that the Cooperative dimension emerges as a distinct factor, rather than merging with the Communicative dimension as occurs in some models in the literature (Ríos et al., 2023), suggests that for early childhood educators, participation in research networks and collaborative work have their own functional logic, distinct from the academic communication of results. This finding is consistent with the arguments of Omar and Capdevila (2013),

who contend that in initial teacher training, the collaborative component of research has its own pedagogical specificity. On the other hand, the high overall internal consistency ($\alpha = 0.924$), along with the differentiated values by dimension (0.713–0.861), indicates that the instrument measures a unitary construct with distinguishable facets: the most basic dimensions—Exploratory and Cognitive—present the highest alphas, suggesting greater homogeneity among their items, while the higher-order dimensions—Methodological and Cooperative—show greater internal variance, reflecting the complexity and heterogeneity of the competencies they represent. This internal hierarchy of the construct is itself a finding that deserves attention in future research on the progressive development of research skills in teachers.

The instrument refinement process—which reduced the initial version from 36 to 26 items through the elimination, modification, and substitution of items—is not a minor achievement: it is methodological evidence in itself. The difficulty in formulating items that were simultaneously coherent with the theoretical construct, appropriate for a frequency scale, clear for early childhood educators, and relevant to their actual working conditions, highlights that operationalizing research skills in this teacher profile is more complex than in university populations. Expert 3's observation in the expert review, regarding the confusion between measuring whether the teacher conducts research versus whether the teacher promotes research among their students, reveals a conceptual challenge that the literature on the instrumentation of research skills has addressed only briefly: the ambiguity of the teacher-researcher's role when their work focuses on the first years of life. This conceptual tension, resolved in the HIDEI (Early Childhood Education Research Institute) by focusing exclusively on the teacher's capacities as a research subject, should guide the design of future instruments in this field.

The findings of this study open at least three lines of research that constitute identifiable gaps in the current state of knowledge. The first and most immediate is the confirmatory validation of the instrument through confirmatory factor analysis (CFA) in an independent sample, an essential step to corroborate the invariance of the five-factor structure and overcome the limitations inherent in the exploratory nature of this study. Additionally, calculating McDonald's omega coefficient (ω) is recommended as a more robust measure of internal consistency than alpha in multidimensional structures. The second gap concerns the digital dimension of research skills: the HIDEI does not include items related to the use of reference managers, academic databases, qualitative or quantitative analysis software, or competencies for scientific communication in digital environments. This gap becomes relevant in light of the work of Torres Delgado and Hernández-Gress (2021), who, in validating their self-assessment model for research professors, explicitly included the "technology user" domain as one of the four core competencies of the contemporary researcher, obtaining some of the highest alpha scores in their instrument for this domain. The absence of this component in the HIDEI does not constitute a weakness for its current application context, but it does limit its scope and points to a priority direction for future versions, especially within the framework of Colombia's open science and educational digitization policy. The third gap is criterion validity: there is still no evidence of the relationship between HIDEI scores and objective indicators of research output—publications, participation in projects, presentations—a relationship that would allow for the establishment of interpretive cut-off points and enhance the diagnostic utility of the instrument.

In terms of implications, the HIDEI has potential for use at three interconnected levels. At the institutional level, faculties of education and teacher training colleges can use it as a diagnostic tool at the beginning and end of teacher training programs, allowing them to evaluate the impact of curricular strategies aimed at developing research skills, in line with the suggestion by Álvarez Gómez et al. (2022) regarding the need to accompany training processes with monitoring tools. At the level of educational policy, the education secretariats and the Colombian Ministry of National Education now have a

validated instrument that can be integrated into teacher evaluation systems differentiated by educational level, helping to overcome the homogenization that characterizes current measurement instruments, which do not distinguish the particularities of teaching practice in early childhood education. At the research level, HIDEI enables comparative studies between regions, types of institution and sociodemographic variables that allow the identification of contextual factors that favor or hinder the development of research skills in early childhood teachers, a research agenda that Vega Fajardo and Vargas Amézquita (2024) identify as necessary and scarcely developed in the region.

6. Conclusions

This study successfully designed and psychometrically validated the HIDEI Scale, a 26-item instrument organized into five dimensions (Exploratory, Cognitive, Methodological, Communicative, and Cooperative) for measuring research skills in early childhood education teachers in Colombia. The instrument demonstrated adequate psychometric properties: an overall content validity of 0.70 obtained through expert judgment and Aiken's V coefficient, a factor structure consistent with the theoretical model supported by an exploratory factor analysis (EFA) with a KMO index of 0.917, and high internal consistency ($\alpha = 0.924$ overall; dimensions: 0.713–0.861).

The HIDEI scale fills an instrumental gap in the field of measuring teaching competencies in early childhood education and constitutes a reliable tool for the diagnosis, monitoring, and evaluation of research skills in this teaching profile. Further progress is recommended toward confirmatory validation of the instrument, a study of measurement invariance by sex, type of institution, and geographic area, as well as an analysis of its criterion validity in relation to objective indicators of teacher research output.

References

- Álvarez Gómez, LK, Ponce Ruiz, DV, Reyes Sánchez, VM, & Campuzano Carriel, CJ (2022). The formation of investigative skills in high school students. *Insutec case*. Cuban Journal of Higher Education, 41(2). http://scielo.sld.cu/scielo.php?pid=S1990-86442022000200100&script=sci_arttext
- Álvarez-Ochoa, R., Román-Collazo, CA, Conchado-Martínez, J., & Cordero-Cordero, G. (2020). Characterization of research skills of teaching staff. *Pedagogical Sciences and Innovation*, 8(2). <https://incyt.upse.edu.ec/pedagogia/revistas/index.php/rcpi/article/view/370>
- Arévalo, L., Burgos, M., & Medina, K. (2017). Theoretical contributions that contribute to the development of critical thinking in early childhood education in Bogotá [Undergraduate thesis]. Francisco José de Caldas District University. <http://hdl.handle.net/11349/8875>
- Avendaño, W., Hernández, C., & Gamboa, A. (2021). Validation of a scale to evaluate research competencies in primary and secondary school teachers. *Revista Boletín Redipe*, 10(6), 200–214. <https://doi.org/10.36260/rbr.v10i6.1335>
- Baldo, J., Pacheco, M., & Rangel, M. (2015). Measurement of research competencies in teachers affiliated with the Department of Social Sciences at the National Experimental University of Táchira. *Aibi Journal of Research, Administration and Engineering*, 3(2). <https://revistas.udes.edu.co/aibi/article/view/1757>
- Carrera, B., & Mazzarella, C. (2001). Vygotsky: sociocultural approach. *Educere*, 5(13), 41–44. <https://www.redalyc.org/articulo.oa?id=35601309>
- Castillo, S. (2011). Evaluation of research competencies [Paper]. XIII Inter-American Conference on Mathematics Education (CIAEM-IACME), Recife, Brazil. https://xiii.ciaem-redumate.org/index.php/xiii_ciaem/xiii_ciaem/paper/viewFile/1588/1095
- Chávez, C., Falquez, J., Farfán, N., & San Lucas, H. (2023). Construction and validation of a research skills scale for university students. *Revista Innova Educación*, 5(2), 62–78. <https://doi.org/10.35622/j.rie.2023.02.004>

Design and validation of an instrument for
measuring research skills in Early Childhood
Education teachers

- Guerra, J. (2020). Constructivism in education and the contribution of Vygotsky's sociocultural theory to understanding the construction of knowledge in human beings. *Contemporary Dilemmas: Education, Politics and Values*, 7(2), art. 77. <https://doi.org/10.46377/dilemas.v7i2.2033>
- Hair, JF, Black, W.C., Babin, B.J., & Anderson, R.E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.
- Hernández, C., Gamboa, A., & Avendaño, W. (2021). Validation of a scale to evaluate research competencies in primary and secondary school teachers. *Revista Boletín Redipe*, 10(6), 200–214. <https://doi.org/10.36260/rbr.v10i6.1335>
- Hernández-Nieto, RA (2011). *Data collection instruments in social sciences and biomedical sciences*. University of Los Andes.
- Kaiser, HF (1974). An index of factorial simplicity. *Psychometrika*, 39(1), 31–36. <https://doi.org/10.1007/BF02291575>
- Lloret-Segura, S., Ferreres -Traver, A., Hernández-Baeza, A., & Tomás-Marco, I. (2014). Exploratory factor analysis of items: A practical, revised, and updated guide. *Annals of Psychology*, 30(3), 1151–1169. <https://doi.org/10.6018/analesps.30.3.199361>
- López Balboa, L., Carballoso Acosta, MR, Urra Cabrera, M., Rodríguez Banderas, Y., & Bachiller Morejón, MD (2015). The development of research skills in the training of health professionals. *Edumecentro*, 7(2), 5–19. <https://www.redalyc.org/articulo.oa?id=477347200002>
- Medina, S. (2019). *Teaching strategies and acquisition of research skills in university students* [Master's thesis, Santa María Catholic University]. Repository institutional.
- Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, 50(9), 741–749. <https://doi.org/10.1037/0003-066X.50.9.741>
- Montero, I., & León, OG (2007). A guide for naming research studies in Psychology. *International Journal of Clinical and Health Psychology*, 7(3), 847–862.
- Nunnally, J.C., & Bernstein, I.H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.
- Omar, M., & Capdevila, B. (2013). The development of research skills in the initial training of students. *Gaceta Médica Espirituana*, 15(1). <https://www.redalyc.org/articulo.oa?id=475748682003>
- Pozo, M., Esteves, Z., & Baque, L. (2023). The development of skills and abilities in educational research. *Episteme Koinonía*, 6(11), 109. <https://doi.org/10.35381/ekv6i11.2425>
- Rangel, M. del C. (2019). Development of research skills in higher education students. *RIDE Ibero-American Journal for Educational Research and Development*, 10(19). <https://www.redalyc.org/jatsRepo/727/72759566008/html/index.html>
- Ríos, P., Ruíz, C., Paulos, T., & León, R. (2023). Development of a scale to measure research competencies in university teachers and students. *Areté. Digital Journal of the Doctorate in Education*, 9(17). <https://doi.org/10.55560/arete.2023.17.9.7>
- Torres, A., Campos, M., Morales, L., & García, O. (2020). Construction and validation of an instrument to characterize the teaching competencies of higher education mathematics professors. *Cuban Journal of Higher Education*, 39(5). http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1990-86442020000500295
- Torres Delgado, G., & Hernández-Gress, N. (2021). Research professors' self-assessment of competencies. *Future Internet*, 13(2), 41. <https://doi.org/10.3390/fi13020041>
- Vega, J., & Vargas, S. (2024). Research skills in formal education: a systematic and bibliometric review. *European Public & Social Innovation Review*, 9, 1–20. <https://doi.org/10.31637/epsir-2024-877>