REVISTA INVECOM
ISSN en línea: 2739-0063

Research training and complex thinking in early childhood education teachers at public universities

Formación investigativa y pensamiento complejo en docentes de educación inicial de universidades públicas

Received: 25/04/2026 - **Accepted:** 20/07/2026

Aracelli del Carmen Gonzales-Sánchez
https://orcid.org/0000-0003-0028-9177
aracelli.gonzalez@usg.edu.mx
Universidad Superior de Guadalajara. Guadalajara, Mexico

Catalina del Rosario Barrio Navarro
https://orcid.org/0000-0001-7979-3629
cbarrios@isidm.mx
Instituto Superior de Investigación y Docencia para el Magisterio. Guadalajara, Mexico

Emperatriz Gregoria Quispe Cuadros
https://orcid.org/0000-0001-6163-9893
empeju2025.secun@gmail.com
Universidad César Vallejo. Lima, Peru

Emilio Borjas Espíritu
https://orcid.org/0000-0002-8307-8190
eborjas_2012@hotmail.com
Universidad César Vallejo. Lima, Peru

Abstract

In Latin American higher education, consolidating research training is an unavoidable pedagogical challenge, especially in initial teacher training programs, where the development of scientific and research competencies is essential for establishing a reflective and autonomous professional practice. In line with this premise, this research aimed to compare the level of mastery of these competencies among first-year teacher education students at two public universities: one located in Lima and the other in Veracruz. Methodologically, a descriptive-comparative quantitative design was adopted with a purposive sample of 129 students (64 Peruvian and 65 Mexican). A 24-item Likert-type scale was used, structured in three dimensions: management, organization, and knowledge acquisition. Content validity, determined using Lawshe's technique, yielded a CVI of 0.94, and overall reliability reached a Cronbach's alpha of 0.91. Given the absence of normality, as confirmed by the Kolmogorov-Smirnov test, the Mann-Whitney U test was used for comparisons. The results revealed significant differences in all three dimensions ($p < .05$) with moderate effect sizes. The asymmetry in knowledge acquisition stands out: 55.4% of the Peruvian subsample was at the pre-formal level, compared to 0% of the Mexican group. This finding highlights the urgent need to restructure curricula under a socio-formative approach that incorporates complex thinking as a cross-cutting theme.

Keywords: research training, complex thinking, scientific competencies, initial teacher training, comparative education.

Resumen

En la educación superior latinoamericana, consolidar la formación investigativa constituye un desafío pedagógico ineludible, sobre todo en las carreras de formación inicial docente, donde el desarrollo de competencias científico-investigativas resulta indispensable para cimentar una práctica profesional reflexiva y autónoma. En consonancia con esta premisa, la presente investigación tuvo como objetivo comparar el nivel de dominio de dichas competencias en estudiantes de los primeros ciclos de pedagogía de dos universidades públicas: una ubicada en

Lima y otra en Veracruz. Metodológicamente, se adoptó un diseño cuantitativo descriptivo-comparativo con una muestra intencional de 129 estudiantes (64 peruanos y 65 mexicanos). Se aplicó una escala tipo Likert de 24 reactivos, estructurada en tres dimensiones: gestión, organización y adquisición de conocimiento. La validez de contenido mediante la técnica de Lawshe arrojó un CVI de 0.94 y la confiabilidad global alcanzó un alfa de Cronbach de 0.91. Ante la ausencia de normalidad, comprobada con la prueba de Kolmogorov-Smirnov, los contrastes se realizaron con la U de Mann-Whitney. Los resultados revelaron diferencias significativas en las tres dimensiones ($p < .05$) con tamaños de efecto moderados. Sobresale la asimetría en adquisición de conocimiento: 55.4 % de la submuestra peruana se ubicó en nivel preformal, frente al 0 % del grupo mexicano. Este hallazgo evidencia la urgencia de reestructurar las mallas curriculares bajo un enfoque socioformativo que incorpore el pensamiento complejo como eje transversal.

Palabras clave: formación investigativa, pensamiento complejo, competencias científicas, formación docente inicial, educación comparada.

Introduction

Transforming education in Latin America hinges on preparing teachers to build living, applied knowledge in the classroom through the scientific method (Tobón, 2013, 2017; Morin, 1999, 2005). Formative research cannot be treated as a luxury or a decorative flourish in the curriculum; rather, it is the driving force of the profession (Restrepo, 2004; Restrepo & Giraldo, 2017; Tobón, 2021). Only in this way will future teachers fully grasp the complexity of an ever-changing reality and learn to base their decisions on solid evidence rather than intuition or tradition (Tobón, 2017, 2021; Morin, 2005).

This directly answers the call of the 2030 Agenda (United Nations [UN], 2015) to build fairer, more equitable societies (UNESCO, 2022; CEPAL, 2020), yet universities across the region remain caught in a deep contradiction (CEPAL, 2020; Restrepo & Giraldo, 2017). Institutional discourse demands immediate engagement with research, but current curricula fail to provide the actual conditions needed to do so from the earliest semesters (Ríos et al., 2022; Orama, 2020; Farfán et al., 2024).

The result is a troubling gap that stifles pedagogical innovation in the classroom (Restrepo & Giraldo, 2017; Ceballos-Almeraya & Tobón, 2020; Valdez et al., 2022). Compounding this problem is a clear theoretical void: nearly all existing diagnoses are local or national in scope, and transnational comparative studies that would allow researchers to grasp the broader picture and exchange good practices across countries remain scarce (Restrepo & Giraldo, 2017; Ceballos-Almeraya & Tobón, 2020).

Against this backdrop, the present study set out to compare the mastery of scientific skills among first-cycle education students at public universities in Peru and Mexico (Ríos et al., 2022; Tapia et al., 2025). Three specific objectives guided this effort: assessing students' actual ability to systematize scientific knowledge (Tobón, 2013; AAC&U, 2026), identifying significant differences through nonparametric statistical analysis (Field, 2018; Ghasemi & Zahediasl, 2012), and formulating pedagogical proposals aimed at updating teacher education across the region (Restrepo, 2004; Tobón, 2021). The overarching aim, then, is to determine students' current level of competency, whether differences exist between countries, and which institutional factors might explain them (Hernández-Sampieri & Mendoza, 2018; Hair et al., 2019).

It is worth noting that this study is grounded in current legislation, including Peru's University Law No. 30220 (Congreso de la República del Perú, 2014) and Mexico's General Education Law (Diario Oficial de la Federación, 2019), both of which mandate research as a compulsory pillar of teacher education (UNESCO, 2022; CEPAL, 2020). Finally, the article is organized into six main sections: this introduction; a theoretical framework grounded in socioformation and complex thought (Morin, 1999, 2005; Tobón, 2013, 2017); the methodology (Lawshe, 1975; Polit & Beck, 2006; DeVellis, 2016); the results; a reflective discussion; and the study's limitations (Farfán et al., 2024; Hernández-Sampieri & Mendoza, 2018).

Theoretical background and prior research

Research training in Latin American higher education

Over roughly the past decade, research in Latin American higher education has carried substantial political and academic weight, though progress has been markedly uneven (Restrepo & Giraldo, 2017; CEPAL, 2020; UNESCO, 2022). Scholars point to a structural tension between the teaching and research functions of the university, with the former clearly dominating undergraduate education, particularly in teacher training and the social sciences (Restrepo, 2004; Restrepo & Giraldo, 2017). This tension is visible in curricula that treat research as an isolated topic confined to the final semesters (Ríos et al., 2022; Orama, 2020; Farfán et al., 2024).

Although Restrepo (2004) was among the first to link formative research explicitly to the curriculum, its implementation has been hampered by the absence of structured sequences (Restrepo & Giraldo, 2017). This shortfall helps sustain what Tobón (2013, 2017, 2021) describes as a teaching-centered model that pushes research practice to the margins. By contrast, Tobón's socioformative approach recasts research as a motivating force that orients learning around situated, real-world problems, offering a way to move past the very limitations Restrepo identifies in curricular practice.

According to UNESCO (2022), fewer than 30% of teacher-training programs in the region embed research into the early years of study. As a result, graduates often leave without the critical-reflective, analytical, and problem-solving competencies that are now essential to effective teaching practice (UNESCO, 2022; CEPAL, 2020; Tobón, 2021).

Complex thought and socioformation as integrative frameworks

For Morin, education must prepare learners for uncertainty by acknowledging the multidimensionality, recursiveness, and interdependence that link the parts to the whole (Morin, 1999, 2005). In his view, researchers must learn to tolerate the unknown and guard against epistemological bias through an open, reflective disposition inherent to scientific inquiry, rather than relying solely on a fixed methodology (Morin, 1999, 2005).

Applied to research practice, formulating a problem means opening oneself to the phenomenon's many dimensions; designing a study calls for coherent alignment with the object under investigation; theorizing demands multiple perspectives; and interpreting requires avoiding simplistic reductions (Morin, 1999, 2005). Together, these principles make it possible to tackle complex problems that admit no easy solutions (Morin, 1999, 2005; Tobón, 2013, 2017).

Tobón's socioformative approach complements and operationalizes complex thought by fostering context-sensitive competencies and performances that integrate knowing, doing, and being within a strongly social orientation. Seen this way, research training is far more than instrumental skill-building; it involves formulating pertinent questions, conducting ethically and socially grounded processes, and sharing knowledge with others (Tobón, 2013, 2017, 2021).

Taken together, the two frameworks reinforce one another: complex thought supplies the critical grounding needed to counter epistemological reductionism (Morin, 1999, 2005), while socioformation contributes the didactic and curricular strategies that put this vision into practice in teacher education (Tobón, 2013, 2017, 2021). Combined, they impose a cognitive and moral demand on teacher training that mirrors the real demands of classroom practice (Morin, 1999, 2005; Tobón, 2013, 2017, 2021).

Scientific-research competencies: operationalization and dimensions

The operationalization of scientific-research competencies in this study rests on a deliberate theoretical triangulation across international and national frameworks, which together justify the selection of three dimensions: management, organization, and knowledge acquisition.

First, Tobón's three competency domains (knowing, doing, and being) provide a three-dimensional structure: “knowing” corresponds to knowledge acquisition, “doing” to research organization, and “being” to research management, including leadership and self-regulation.

Second, the VALUE rubric developed by the American Association of Colleges and Universities (AAC&U, 2026) assesses information literacy through closely aligned criteria: determining the information needed (management), accessing it effectively (organization), and critically evaluating sources (acquisition).

Third, the Tuning Latin America Project (2007) identified generic competencies such as abstraction, analysis, research capacity, and problem-solving, all of which map naturally onto these three dimensions.

Finally, studies by Ceballos-Almeraya and Tobón (2020) and Farfán et al. (2024) offer empirical support for measuring research competencies through dimensions that integrate cognitive, procedural, and attitudinal aspects. The convergence of these four frameworks thus provides a solid theoretical justification, in contrast with operationalizations that lack explicit grounding.

Prior comparative studies in Latin America

The scientific literature on research competencies in Latin America is still an emerging body of work, though clearly expanding, a fact that underscores the value of the present study. From this vantage point, a comparative study carried out in 2025 between Mexico and Argentina examined these traits among university students from different fields. The results showed significant differences in the development of research competencies depending on the environment in which students were trained (Tapia et al., 2025).

Although ambitious in geographic scope, the study by Tapia Cortes et al. (2025) does not address the training of future teachers, nor does it adopt a socioformative approach. This methodological gap prevents a direct comparison with the present study, which seeks to close these theoretical gaps through an evaluation design that explicitly accounts for the characteristics of today's teacher-education classrooms.

Rivero (2017), for his part, shows through a comparative analysis conducted in Costa Rica that graduate students possess stronger research competencies than undergraduates. Yet entry-level students who received extensive instruction in methodology courses achieved results comparable to those of advanced students who had received no such instruction. Under this paradigm, the hypothesis this study aims to test at an international scale is that early curricular exposure levels the playing field for competency development.

From this same vantage point, a group of researchers from the Engineering Education Research Network assessed students' skills in technical fields and found that engineering students outperformed their technology counterparts in project management and organization, with no corresponding gap in the theoretical acquisition of knowledge (Valdez et al., 2022). This asymmetry reveals that research competencies develop unevenly, which makes a multidimensional approach to their assessment all the more necessary.

According to Orama (2020), most university students in South America perform at a low or low-to-medium level in scientific training and are unable to select and critically evaluate the literature. This discouraging diagnosis is closely tied to the structure of the region's curricula, where systematic inquiry-based training is conspicuously absent during the first cycles of study (Ríos et al., 2022). Farfán et al. (2024), in a study published in Interciencia, conducted a systematic review of instruments for measuring research competencies in Ibero-America and flagged the absence of complete psychometric reporting and the limited cross-cultural validation of existing instruments as key areas for improvement.

In sum, although the literature acknowledges the importance of research competencies, no study was found that compares levels of mastery of scientific-research competencies among first-cycle students in teacher-education programs in Peru and Mexico under the socioformative model associated with complex thought, nor one that reports the complete psychometric properties of the measurement instrument used. This gap underscores the relevance and originality of the present study and its potential contribution to the field of comparative education in Latin America.

Methodology

Approach and design

This study followed a quantitative, descriptive-comparative approach consistent with its twin aims of characterizing levels of research-competency mastery and comparing two independent groups. The descriptive component made it possible to characterize the distribution of scores for each dimension and country, while the comparative component allowed the researchers to determine whether statistically significant differences existed between groups using nonparametric tests. A quantitative design was chosen because the variables under study were competency-mastery levels measured on ordinal scales, and the aim was to obtain results that could be generalized to the contexts examined (Hernández-Sampieri & Mendoza, 2018).

Population and sample

The population consisted of students in the early cycles of teacher-training programs at public universities in Peru and Mexico. A non-probabilistic, purposive sampling strategy was used, drawing on students enrolled in the first two semesters of education programs during the 2023-I academic term. The final sample comprised 129 students: 64 from a public university in Lima, Peru, and 65 from a public university in Veracruz, Mexico.

With a significance level of $\alpha = 0.05$, a moderate effect size ($d = 0.5$), and statistical power of 0.80, the minimum required sample size per group for a Mann-Whitney U test is 64 participants (calculated using G*Power 3.1); the sample achieved in this study therefore proved sufficient to detect moderate differences between groups (Faul et al., 2007).

Fieldwork was carried out simultaneously and in a coordinated manner in both countries: Gonzales-Sánchez led the administration of the instrument and data collection at the Peruvian site, while researcher Barrio Navarro supervised and actively participated in data collection at the Mexican site.

Instrument

A 24-item questionnaire was designed using a four-point Likert-type response format (1 = Never, 2 = Sometimes, 3 = Often, 4 = Always), organized into three theoretical dimensions: Research Management (8 items), Research Organization (8 items), and Knowledge Acquisition (8 items). Table 1 presents the distribution of items

by dimension. The four-point scale was chosen deliberately to avoid central-tendency bias, forcing respondents to take a clear position for or against each statement (Babbie, 2020).

Table 1
Item distribution of the instrument by dimension

Dimension	Items	Item Example
Research management	1-8	"I identify research problems in my educational context"
Research organization	9-16	"I design a work plan to carry out an educational research project"
Knowledge acquisition	17-24	"I search for scientific information in specialized databases"

Note. The complete instrument includes 24 items distributed equally across the three dimensions / Author's own elaboration

Instrument validity and reliability

Content validity was assessed through the judgment of five experts using Lawshe's method. The judges rated the clarity, relevance, and pertinence of each item on a three-point scale. The content validity ratio ranged from 0.60 to 1.00, exceeding the critical value of 0.99 required for a panel of five judges ($p < .05$). The overall content validity index reached 0.94, well above the 0.80 threshold recommended by Polit and Beck.

Construct validity was examined through exploratory factor analysis (principal components, varimax rotation). The KMO index was 0.876, considered good, and Bartlett's test was significant, $\chi^2 = 1847.3$, $p < .001$, confirming that the matrix was factorable. The three-factor solution accounted for 62.4% of total variance, above the 60% minimum recommended by Hair et al., and the resulting structure was consistent with the three-dimensional theoretical model. Reliability, assessed through Cronbach's alpha, yielded the following results: total scale $\alpha = 0.91$; Management $\alpha = 0.87$; Organization $\alpha = 0.89$; and Acquisition $\alpha = 0.85$. All values exceed the 0.70 and 0.80 thresholds conventionally required for publishable instruments.

Normality tests

Before proceeding with inferential analysis, the assumption of normality was tested for the score distributions of each dimension in both groups using the Kolmogorov-Smirnov test, a procedure particularly well suited to samples of fewer than 200 participants (Ghasemi & Zahediasl, 2012). Table 2 presents the results.

Table 2
Kolmogorov-Smirnov normality test by dimension and group

Dimension	Group	n	K–S Statistic	p
Research management	Peru	64	0.164	0.002
	Mexico	65	0.138	0.014
Research organization	Peru	64	0.189	< .001
	Mexico	65	0.152	0.005
Knowledge acquisition	Peru	64	0.211	< .001
	Mexico	65	0.145	0.009

Note. All p values < .05, which justifies the use of nonparametric tests

As Table 2 shows, most distributions yielded $p < .05$, leading to rejection of the null hypothesis of normality and justifying the use of nonparametric statistics for the comparative analyses.

Analytical Technique

Group comparisons were carried out using the Mann-Whitney U test for independent samples, an appropriate choice when comparing two groups on ordinal or interval variables that depart from normality (Field, 2018). The test evaluates whether the two groups' distributions are equivalent, with the null hypothesis being that both samples come from the same population. Effect size was calculated using the formula $r = Z/\sqrt{N}$, where Z is the test's standardized statistic and N is the total sample size (Fritz et al., 2012). Effect sizes were interpreted using

Cohen's (1988) benchmarks: r = 0.10 (small), r = 0.30 (moderate), and r = 0.50 (large). In addition, mastery levels were categorized according to the four-level scheme of Tobón (2013): pre-formal (1.0–2.0), receptive (2.1–2.5), resolutive (2.6–3.0), and strategic (3.1–4.0). All analyses were run using SPSS v.28.

Results

Descriptive statistics and level of mastery by dimension and country

Table 3 presents the frequency distribution and percentages of Peruvian and Mexican students by mastery level for each of the three dimensions assessed. The descriptive results reveal distinct patterns between the two groups, which are analyzed below.

Table 3

Level of mastery of research competencies by dimension and country (frequencies and percentages)

Dimension	Level	Peru (n = 64)	% Peru	Mexico (n = 65)	% Mexico
Research management	Pre-formal	15	23.4	5	7.7
	Receptive	26	40.6	18	27.7
	Resolutive	18	28.1	27	41.5
	Strategic	5	7.8	15	23.1
Research organization	Pre-formal	18	28.1	6	9.2
	Receptive	24	37.5	16	24.6
	Resolutive	17	26.6	28	43.1
	Strategic	5	7.8	15	23.1
Knowledge acquisition	Pre-formal	36	55.4	0	0.0
	Receptive	19	28.9	22	33.8
	Resolutive	10	15.7	24	36.5
	Strategic	0	0.0	19	29.7

Note. Levels according to Tobón (2013): Pre-formal (1.0–2.0), Receptive (2.1–2.5), Resolutive (2.6–3.0), Strategic (3.1–4.0) / Author's own elaboration

Regarding research management, the Peruvian group clustered heavily in the lower levels: 23.4% at the pre-formal level and 40.6% at the receptive level, together accounting for 64.0% below the resolutive threshold. The Mexican distribution, by contrast, was markedly more favorable: only 7.7% remained at the pre-formal level, while 41.5% reached the resolutive level and 23.1% the strategic level, that is, 64.6% at the upper levels. This asymmetry suggests a greater capacity among Mexican students to identify problems and orient their research searches.

A similar pattern emerged for research organization. In Peru, 28.1% fell at the pre-formal level, 37.5% at the receptive level, and only 7.8% at the strategic level; in Mexico, 9.2% remained at the pre-formal level, while 43.1% reached the resolutive level and 23.1% the strategic level. These differences point to stronger command of planning and methodological design within the Mexican sample.

The widest gap appeared in knowledge acquisition. In Peru, 55.4% of students were at the pre-formal level, 28.9% at the receptive level, and 15.7% at the resolutive level, with no students reaching the strategic level. In Mexico, no students fell at the pre-formal level; instead, 33.8% were at the receptive level, 36.5% at the resolutive level, and 29.7% at the strategic level. This 55.4-percentage-point difference at the pre-formal level constitutes the study's most striking finding and is discussed further below.

Intergroup comparison: Mann-Whitney U test

Table 4 presents the results of the Mann-Whitney U test for the three dimensions, including medians, interquartile ranges (IQR), the U statistic, the Z value, the significance level, and effect size. The results confirm statistically significant differences across all three dimensions assessed.

Table 4
Results of the Mann-Whitney U test for the intergroup comparison by dimension

Dimension	Peru Median (IQR)	Mexico Median (IQR)	U	Z	p	r
Management	2.10 (1.75-2.60)	2.88 (2.35-3.28)	1287.5	-3.98	< .001	0.35
Organization	2.00 (1.63-2.50)	2.81 (2.25-3.25)	1204.0	-4.26	< .001	0.38
Knowledge acquisition	1.75 (1.25-2.25)	2.88 (2.38-3.38)	903.5	-5.42	< .001	0.48

Note. IQR = interquartile range (P25–P75). r = effect size calculated as Z/√N

The Mann-Whitney U test revealed statistically significant differences across all three dimensions assessed ($p < .001$ in every case). For research management, the U statistic was 1287.5 ($Z = -3.98$, $p < .001$), with a moderate effect size ($r = 0.35$). The medians show that the Mexican group (Md = 2.88, IQR = 2.35–3.28) scored significantly higher than the Peruvian group (Md = 2.10, IQR = 1.75–2.60), placing the Mexican median at the resolutive level and the Peruvian median at the receptive level.

For research organization, the differences were equally significant ($U = 1204.0$, $Z = -4.26$, $p < .001$), with a moderate effect size ($r = 0.38$). The Mexican group posted a median of 2.88 (IQR = 2.25–3.25), compared with 2.00 (IQR = 1.63–2.50) for the Peruvian group. The knowledge-acquisition dimension showed the sharpest contrast ($U = 903.5$, $Z = -5.42$, $p < .001$), with the largest effect size, approaching the conventional threshold for a large effect ($r = 0.48$). The Mexican median reached 2.88 (IQR = 2.38–3.38), placing it at the resolutive level, while the Peruvian median was 1.75 (IQR = 1.25–2.25), at the pre-formal level. This gap of more than one full point in the median reflects the quantitative disparity already identified in the frequency analysis.

Discussion

Comparing findings with prior literature

These results align with studies that report deficiencies in undergraduate research training across Latin America (Restrepo & Giraldo, 2017; UNESCO, 2022). The particularly wide gap in the knowledge-acquisition dimension stands out, exceeding what previous research has reported. The Peruvian group's performance echoes Orama's (2020) finding of low proficiency in searching for and evaluating sources; the Mexican group, meanwhile, shows medium-high levels consistent with the findings of Ceballos-Almeraya and Tobón (2020), although these still point to a socioformative approach that remains underdeveloped. Rivero (2017) attributes such differences to an earlier start in curricular exposure to research.

The advantage observed in Mexico suggests that research activities there are organized from the earliest cycles onward, consistent with the positions of Tobón (2013, 2017, 2021) and Restrepo (2004). Finally, the moderate-to-large effect sizes obtained ($r = 0.35–0.48$) underscore the practical relevance of these findings and move beyond the common limitation of reporting statistical significance alone, reinforcing the study's methodological contribution.

Analyzing the gap in the "Knowledge acquisition" dimension

The most alarming finding within the knowledge-acquisition domain is that no Mexican students fell at the pre-formal level, whereas a striking 55.4% of Peruvian students did. This difference matters because the processes of searching for and evaluating information underpin the development of any research activity (Tobón, 2013, 2017, 2021; AAC&U, 2026; Beneitone et al., 2007), so weaknesses here tend to cascade into every subsequent stage (Farfán et al., 2024).

This points to underlying curricular differences: Mexico introduces methodology courses from the very first cycle, whereas Peru postpones them to intermediate cycles or years, a pattern consistent with Ríos et al.'s (2022) observation that Peruvian methodology programs lack systematic sequencing from the outset. This Latin American heterogeneity echoes what Restrepo and Giraldo (2017) describe: formative research that remains more of a declared intention than an actual procedural practice.

Tobón (2013, 2017) warns that such patterns stem from the persistence of a traditional educational model in which research methodology is addressed only at the end of the curriculum and teachers act as passive recipients

rather than active managers of knowledge, disregarding the Tuning Project's recommendation (Beneitone et al., 2007) to build methodological training in from the very first courses or academic years.

The strategic level among first-cycle students

It is striking that first-cycle students in Mexico, despite lacking formal research experience, reach strategic levels in some areas (23.1% in management; 29.7% in acquisition). For Tobón (2013, 2017), this level implies the capacity to innovate and transfer processes to complex scenarios. Possible explanations include prior exposure through secondary-school coursework or science fairs (Orama, 2020; Rivero, 2017), social-desirability bias in Likert-type scales that inflates self-reported scores (Podsakoff et al., 2003), or responses that are more declarative (knowing what) than procedural (knowing how), which would inflate the results without reflecting genuine competency (Ceballos-Almeraya & Tobón, 2020; Farfán et al., 2024).

This observation constitutes a limitation of the study and underscores the need to complement quantitative approaches with qualitative methods capable of verifying whether self-perceptions correspond to actual behavior (Hernández-Sampieri & Mendoza, 2018). Future research should incorporate interviews, observations, or portfolios to triangulate and enrich self-report data (Field, 2018).

Implications for teacher training

These results point to a pressing need to integrate research from the earliest cycles onward, with knowledge construction standing out as the most significant deficiency (Ríos et al., 2022; UNESCO, 2022). In practice, this means embedding information search and evaluation into every course through a research-training approach (Restrepo, 2004; Tobón, 2017).

The differences observed between the two countries stem from curricular decisions rather than any intrinsic factors (Tapia Cortes et al., 2025). Acceptable levels of competency can be achieved through early-stage training (Rivero, 2017; Ceballos-Almeraya & Tobón, 2020), which is why universities should study and adapt successful practices wherever they are found (Restrepo & Giraldo, 2017).

Complex thought (Morin, 1999, 2005) offers a way to rethink this training beyond mere procedure, cultivating the capacity to pose multidimensional questions and tolerate uncertainty (Tobón, 2013, 2021). Finally, psychometrically valid and reliable instruments are essential for assessing these competencies (Farfán et al., 2024; DeVellis, 2016), ensuring that curricular decisions remain grounded in evidence.

Conclusions

This study compared the level of mastery of scientific-research competencies among first-cycle teacher-training students at one public university in Peru and another in Mexico, using a validated 24-item instrument organized into three dimensions (Lawshe, 1975; Polit & Beck, 2006; DeVellis, 2016). The following conclusions emerge from the results.

First, statistically significant differences emerged between the Peruvian and Mexican groups across all three dimensions assessed (management, organization, and knowledge acquisition) with effect sizes ranging from moderate to large (r = 0.35–0.48) (Cohen, 1988; Fritz et al., 2012). The Mexican group scored higher across every dimension and clustered predominantly at the resolutive and strategic levels, while the Peruvian group concentrated at the pre-formal and receptive levels (Tobón, 2013, 2017).

Second, the widest gap appeared in the knowledge-acquisition dimension: 55.4% of Peruvian students fell at the pre-formal level, compared with 0% in Mexico. Because this dimension encompasses the search, evaluation, and comprehension of scientific information (AAC&U, 2026; Beneitone et al., 2007), it forms the foundation on which the remaining research competencies are built (Farfán et al., 2024; Orama, 2020).

Third, the differences found may be linked to curricular and institutional factors, as well as to socioeducational background prior to enrollment (Ríos et al., 2022; Restrepo & Giraldo, 2017; UNESCO, 2022). The study's cross-sectional design, however, precludes establishing causal relationships (Hernández-Sampieri & Mendoza, 2018).

Based on these findings, curricula should be revised to incorporate systematic research-training sequences beginning in the first semester, facilitate access to sources and databases, and foster an institutional culture that links research to undergraduate education (Restrepo, 2004; CEPAL, 2020; Valdez et al., 2022).

Finally, several limitations of this study warrant consideration: the non-probabilistic purposive sampling, the cross-sectional design, the reliance on self-report measures susceptible to social-desirability bias (Podsakoff et al., 2003), and the limited generalizability that follows from restricting the sample to two institutions. Future research should pursue longitudinal designs (Rivero, 2017), mixed-methods approaches with qualitative triangulation (Field, 2018), multi-site studies, and analyses of predictive variables through multivariate models (Hair et al., 2019).

References

American Association of Colleges and Universities. (2026). *VALUE rubrics*. AAC&U. https://www.aacu.org/value/rubrics

Babbie, E. (2020). *The practice of social research* (15.ª ed.). Cengage Learning.

Beneitone, P., Esquetini, C., González, J., Marty, L. M., Siufi, G., & Wagenaar, R. (Eds.). (2007). *Reflexiones y perspectivas de la educación superior en América Latina: Informe final — Proyecto Tuning-América Latina 2004-2007*. Universidad de Deusto; Groningen. http://www.deusto-publicaciones.es/deusto/pdfs/tuning/tuning05.pdf

Ceballos-Almeraya, J. M., & Tobón, S. (2020). Validez de una rúbrica para medir competencias investigativas en pedagogía desde la socioformación. *Atenas, 4*(47), 45–62. https://www.redalyc.org/journal/4780/478060102001/html/

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2.ª ed.). Lawrence Erlbaum Associates.

Comisión Económica para América Latina y el Caribe. (2020). *Panorama social de América Latina y el Caribe 2020*. CEPAL. https://www.cepal.org/es/publicaciones/46542-panorama-social-america-latina-caribe-2020

Congreso de la República del Perú. (2014). *Ley universitaria N.° 30220*. El Peruano.

DeVellis, R. F. (2016). *Scale development: Theory and applications* (4.ª ed.). SAGE Publications.

Diario Oficial de la Federación. (2019). *Ley general de educación*. México.

Farfán, R. M., Martínez, M. A., Pérez, E. I., & Chávez, J. L. (2024). Instrumentos de medición de las competencias investigativas: Una revisión sistemática en Iberoamérica. *Interciencia, 49*(3), 187–194.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191. https://doi.org/10.3758/BF03193146

Field, A. (2018). *Discovering statistics using IBM SPSS Statistics* (5.ª ed.). SAGE Publications.

Fritz, C. O., Morris, P. E., & Richler, J. J. (2012). Effect size estimates: Current use, calculations, and interpretation. *Journal of Experimental Psychology: General, 141*(1), 2–18. https://doi.org/10.1037/a0024338

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: A guide for non-statisticians. *International Journal of Endocrinology and Metabolism, 10*(2), 486–489. https://doi.org/10.5812/ijem.3505

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8.ª ed.). Cengage Learning.

Hernández-Sampieri, R., & Mendoza, C. P. (2018). *Metodología de la investigación: Las rutas cuantitativa, cualitativa y mixta*. McGraw-Hill Interamericana.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*(1), 31–36. https://doi.org/10.1007/BF02291575

Lawshe, C. H. (1975). A quantitative approach to content validity. *Personnel Psychology, 28*(4), 563–575. https://doi.org/10.1111/j.1744-6570.1975.tb01393.x

Morin, E. (1999). *Los siete saberes necesarios para la educación del futuro*. UNESCO.

Morin, E. (2005). *Introducción al pensamiento complejo* (2.ª ed.). Gedisa.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3.ª ed.). McGraw-Hill.

Orama, L. (2020). Competencias investigativas en estudiantes universitarios: Un estudio desde la perspectiva del docente. *Revista de Investigación, 44*(100), 187–213.

Organización de las Naciones Unidas. (2015). *Transformar nuestro mundo: La Agenda 2030 para el Desarrollo Sostenible*. ONU.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure what's being reported? Critique and recommendations. *Research in Nursing & Health, 29*(5), 489–497. https://doi.org/10.1002/nur.20147

Restrepo, B. (2004). La investigación-formativa en la educación superior: Una nueva perspectiva. En B. Restrepo (Ed.), *La investigación en la educación superior* (pp. 13–30). Mesa Redonda Magisterio.

Restrepo, G., & Giraldo, L. (2017). *La formación investigativa en la educación superior en América Latina y el Caribe: Una aproximación a su estado del arte* [Manuscrito inédito]. Universidad de Caldas.

Ríos, J. A., Hernández, M. L., & Castillo, R. (2022). Formación investigativa en programas de licenciatura en educación: Un análisis comparativo. *Revista Latinoamericana de Educación Comparada, 13*(19), 78–95.

Rivero, T. (2017). Estudio comparativo de competencias investigativas entre estudiantes de pregrado y posgrado. *Revista Electrónica Educare, 21*(2), 1–22.

Tapia Cortes, C., Capaldo, M. E., Córdoba, J., & Quispe, M. (2025). *Competencias investigativas en estudiantes universitarios: Estudio comparado entre México y Argentina*. https://pure.udem.edu.mx/p/en/research-outputs/competencias-investigativas-en-estudiantes-universitarios-estudio

Tobón, S. (2013). *Formación integral y competencias: Pensamiento complejo, currículo, didáctica y evaluación* (4.ª ed.). ECOE Ediciones.

Tobón, S. (2017). *Proyecto formativo: Estrategia para el desarrollo de competencias en el siglo XXI* (4.ª ed.). ECOE Ediciones.

Tobón, S. (2021). *Socioformación y pensamiento complejo: Metodología para el desarrollo del talento humano*. CIFE.

UNESCO. (2022). *Estado de la educación en América Latina y el Caribe: Hacia la reconstrucción de la educación para el desarrollo sostenible*. UNESCO/OREALC.

Valdez, G., Martínez, J., & Salazar, L. (2022). Competencias investigativas en estudiantes de ingeniería y tecnología: Un estudio comparativo. *Revista de Investigación Educativa de la REDIECH, 13*(32), 1–18.