Assessment of research competence in the educational field: an analysis of measurement instruments

Evaluación de la competencia investigativa en el campo educativo: un análisis de los instrumentos de medición

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Abstract

There is a growing interest in the acquisition, promotion, and assessment of the competencies necessary for research among university students. However, within the field of educational evaluation, one confronts the complexity of establishing precise measures that inform about the performance of this competence. This study examined the measurement instruments employed to assess the research competence of university students in the educational field. The research followed the PRISMA protocol for conducting systematic literature reviews and performed a critical analysis of the identified measurement instruments. The aspects under investigation included: proposed use, target population, construct's conceptualization, instrument format, and validity evidence's generation. Findings indicated that these instruments are employed both to assess the acquisition and mastery of research competence and to evaluate the effectiveness of pedagogical interventions aimed at fostering it. A lack of representativeness of the student population in disciplines with an educational focus was identified. The components and indicators of research competence share a common organization into dimensions spanning from metacognitive skills to contextual conditions within which research is practiced. There was an observed tendency towards the use of questionnaires and a prevalence of traditional approaches in validation procedures.

Keywords: research competence, higher education, university students, student evaluation, measuring instrument, educational research.

Resumen

Existe un creciente interés en la adquisición, promoción y evaluación de las competencias necesarias para la investigación en estudiantes universitarios. Sin embargo, en el ámbito de la evaluación educativa, se enfrenta a la complejidad de establecer medidas precisas que informen sobre el desempeño de esta competencia. Este trabajo examinó los instrumentos de medición utilizados para evaluar la competencia investigativa de estudiantes universitarios en el campo educativo. El estudio siguió el protocolo PRISMA para la conducción de revisiones sistemáticas de literatura y realizó un análisis crítico de los instrumentos de medición identificados. Los aspectos bajo estudio fueron: uso propuesto, población objetivo, conceptualización del constructo, formato del instrumento y generación de evidencias de validez. Los hallazgos indicaron que los instrumentos se utilizan tanto para evaluar la adquisición y dominio de la competencia investigativa como para valorar la efectividad de intervenciones pedagógicas destinadas a fomentarla. Se identificó una falta de representatividad de la población estudiantil en disciplinas con enfoque educativo. Los componentes e indicadores de la competencia investigativa comparten una organización común en dimensiones que abarcan desde habilidades meta-cognitivas hasta condiciones contextuales donde se practica la investigación. Se observó una tendencia hacia el uso de cuestionarios y una prevalencia del enfoque tradicional en los procedimientos de validación.

Palabras clave: competencia investigativa, educación superior, estudiantes universitarios, evaluación del estudiante, instrumento de medida, investigación educativa.

1. Introduction

The academic community has focused on the acquisition, promotion and evaluation of the necessary competencies in and for research in university students of various areas of knowledge. This trend has contributed to undertaking studies that have allowed characterizing this competence, as well as proposing methodologies for its study in higher education (Ianni et al., 2019; Paz & Estrada, 2022; Valdiviezo-Villegas et al., 2023; Sandoval-Henríquez & Sáez-Delgado, 2023). The knowledge, skills and attitudes related to scientific work are considered fundamental within the curricular and training projects of universities and institutions of higher education, especially due to its impact on the professional practice of students, the scientific advancement of the fields of study and the contribution to both economic and socio-cultural impulse at regional and national levels (Ciraso-Calí et al., 2022; Colás-Bravo & Hernández, 2021). The investigative competence is a polysemic and multifactorial construct that admits diverse approaches to determine the knowledge, skills, attitudes and values that constitute it. Colás-Bravo and Hernández (2021) point out that some components include problem solving, creativity, argumentative skills, and critical thinking. Likewise, Castillo-Martínez et al. (2021) add the domain over the designs and research approaches, as well as techniques and strategies for data collection and analysis. For their part, Ciras-Calí et al. (2022) incorporate the understanding of principles, concepts and key processes of the discipline from which it is investigated.

In a generalized way, the investigative competence refers to the set of meta-cognitive, cognitive, methodological, operative and affective-attitudinal components used autonomously and flexibly by the student to identify, solve and report on problems from a specific discipline (Espinoza et al., 2016; Estrada, 2014; Martínez-Rizo, 2019; Sandoval-Henríquez & Sáez-Delgado, 2023; Villa, 2005). The acquisition and promotion of this competence is influenced by the student's performance, the teacher's pedagogical intervention and the curricular objectives of the universities' training projects (Hernández et al., 2019). Therefore, Cardoza et al. (2023) argue that it is necessary to formulate policies, programs and strategies aimed at the evaluation of these competencies at the university. These evaluative practices are based on evaluation models distinguished by theoretical perspectives on the teaching-learning process and methodologies with implications in their applications and uses (Mellado-Moreno et al., 2021; Moreno-Olivos, 2021).

In the field of educational evaluation, one of the consolidated lines of research is that aimed at assessing and reporting on the acquisition and progress of the competences developed by the university student during his/her professional training. This is reflected in the extensive academic production around models, techniques and instruments for competency-based assessment in school contexts (Boritz & Carnaghan, 2003; Mejía, 2012; García-Cabrero & Ledesma, 2022; Manzanares & Sánchez-Santamaría, 2016). One of the persistent challenges in assessing professional competencies is to establish how to measure their performance.

The main function of measurement instruments in evaluative processes is to generate a measure that provides relevant information about the construct of interest. This information is essential to support decision-making according to the objectives and purposes of the evaluation program. In this sense, its objective is to provide scores or values of the variables of the construct under evaluation that allow accurate interpretations according to the purposes of the evaluation. Given the importance of these instruments in both summative and formative evaluations, their design and development must follow guidelines or standards recognized by the academic community to ensure their conceptual and technical quality (*e.g.* AERA, APA and NCME, 2018; Downing & Haladyna, 2011; Geisinger et al., 2013; Lane et al., 2016). Some key aspects in its development include the proposed use, target population, conceptualization of the construct, instrument format and generation of validity evidence.

The *proposed use* involves explicitly and clearly indicate how the information provided by the instrument is expected to be interpreted and used. For example, in making decisions about student admission, monitoring academic performance, improving academic performance or developing pedagogical interventions (Linn, 2010). This use or purpose of the instrument has a significant impact on the validity of inferences and conclusions (Hattie & Leeson, 2013). Another important aspect is the delimitation

of the *target population*, i.e. specifying who makes up the intended group of examinees or supporters. This provides an overview for the sampling process and is crucial for the applicability, representativeness and generalization of the results (AERA, APA and NCME, 2018).

One of the main challenges of educational evaluation lies in the *conceptualization of the construct* that is intended to measure. The theoretical and operational definitions of the construct represent a conceptual framework that points to the key components of the construct of interest, such as knowledge, skills, or behaviors. The latter are stated in the form of indicators, so that each component can be captured or recorded using an instrument. Since research competence, like other constructs in educational research, has a complex and multidimensional nature, its conceptual and operational definition must derive from systematic studies to identify and select the components that make it up (Jornet et al., 2011; Lane et al., 2016b).

This frame of reference serves as a starting point for selecting the *format of the instrument*, which varies according to the type of information or result that is expected to generate, its purpose, administration, as well as its modes of operation. These are classified into tests, questionnaires, self-report inventories, scales, observation rubrics, portfolios among others (Ary et al., 2010). Selecting which one to use depends on its relevance and suitability to capture more effectively the indicators set out in the framework.

Finally, the *generation of validity evidence* is a fundamental process to guarantee both the conceptual and technical quality of measurement instruments and evaluative processes in the educational field. Currently, this process is conducted from an argumentative approach (AERA, APA and NCME, 2018). In this perspective, validity refers not only to the numerical value obtained by a statistical index or test, but to the consistency and coherence of the evidence generated to support the inferences and uses of the results of the instrument (Kane, 1992; 2013; Ramos, 2015). This evidence derives from empirical and logical analyses of the information collected for this purpose (AERA, APA and NCME, 2018) as internal consistency indices or alignment processes. In other words, it refers to the body of evidence collected from various sources and through different analysis strategies to inform inferences and uses of the results of the instrument according to the purpose of the evaluation program.

Educational research, as an interdisciplinary field, provides various instruments to inform on the acquisition, mastery and performance of competences among university students. In addition, the specialized literature on the variables of research competence, the interventions aimed at improving it and its evaluation is extensive and timely documented. Systematic reviews of the literature (Sandelowski & Barroso, 2007; Paterson, 2012) are a systematic approach to synthesizing and integrating this body of information to provide an overview of its progress and current status.

Specifically, studies have been conducted from this approach to identify the various components that encompass research competence (*e.g.* Valderrama et al., 2022), to explore how it has been studied (*e.g.* Valdiviezo-Villegas & Leyva-Aguilar, 2023; Sandoval-Henríquez & Sáez-Delgado, 2023) or to analyze the instruments applied to report such competence in disciplines such as medicine or nursing (*e.g.* Ianni et al., 2021; Chen et al., 2021). However, in previous reviews, the recognition of the traits and conditions of research practice in the educational field has been absent. Such as the nature of the phenomena under study, currents and theoretical positions, methodologies, as well as the pedagogical purposes raised in the study programs to train professionals with orientation in this area (Martínez-Rizo, 2019; Villa, 2005). Under this perspective, the objective of this research is to examine the measurement instruments used to evaluate the research competence of university students in the educational field, focusing on fundamental aspects in its design and elaboration, such as: proposed use, target population, conceptualization of the construct, instrument format and generation of validity evidence.

2. Methodology

This research followed the guidelines established by the PRISMA protocol (Urrútia and Bonfill, 2010) for conducting systematic literature reviews, in addition a critical analysis (Sandelowski & Barroso, 2007; Paterson, 2012) of the identified academic production was carried out. This method involved a systematic approach focused on the critical and interpretative integration of literature, beyond a des-

cription of it. The databases consulted were Web of Science, Scopus and Scielo considered as the main repositories of articles related to the educational field in Anglo-Saxon and Ibero-American countries. For searching the documents, 17 terms recovered from previous literature reviews on research competence were used (*e.g.* Castillo-Martínez & Ramírez-Montoya, 2021; Valdiviezo-Villegas & Leyva-Aguilar, 2023), as well as similar exercises carried out in other areas of knowledge (*e.g.* Chen et al., 2021; Ianni et al., 2019). These terms, along with Boolean operators, were used to formulate 10 search strings (see table 1). All identified documents were exported to the Mendeley program for storage and management.

Table 1. *Search strings*

ID	Search string
CB1	("research competence" OR "academic competence") AND ("assessment" OR "measurement")
CB2	("research competence" OR "academic competence") AND "instrument"
CB3	("investigative skill" OR "investigative competence") AND ("evaluation" OR "assessment")
CB4	("investigative skill" OR "investigative competence") AND ("measurement" OR "instrument")
CB5	("research ability" OR "research capability") AND ("evaluation" OR "assessment")
CB6	("research ability" OR "research capability") AND ("measurement" OR "instrument")
CB7	("research competence" OR "research skill") AND ("evaluation" OR "assessment")
CB8	("research competence" OR "research skill") AND ("measurement" OR "instrument")
CB9	("research-based competence" OR "research-based skill") AND ("evaluation" OR "assessment")
CB10	("research-based competence" OR "research-based skill") AND ("measurement" OR "instrument")

The inclusion and exclusion criteria are set out in Table 2. Regarding the *field of study*, it was verified that the articles were related to some discipline within the field of education (*e.g.* pedagogy, educational psychology or teaching). On the other hand, for the *sample* criterion, it was found that the reported sample was composed totally or partially by university students enrolled in bachelor's, master's, specialty or doctoral programs. In relation to the thematic emphasis, it was assessed whether the components subject to measurement were directly related to the investigative competence, i.e. articles where the object of study (*e.g.* deep thinking or creativity) was not explicitly linked to the research work were excluded, even if these components are part of the competence of interest. Finally, the *construct* criterion *subject to measurement* discriminated those investigations in which the application of some instrument was not reported.

Table 2. *Inclusion and exclusion criteria*

Criterion	Inclusion	Exclusion
Document Type	Articles.	Books, book chapters, theses, conference proceedings, reports, reviews.
Type of study	Empirical.	Theoretical-analytical.
Period	2013–2023.	Prior.
Language	Spanish and English.	Another language.
Field of study	Disciplines with an explicit educational approach.	Other disciplines or without information about their educational orientation.
Sample	College students.	Students at other educational levels, teachers and researchers.

Criterion	Inclusion	Exclusion
Thematic emphasis	Components related to investigative competence.	Component isolated or without referring to the investigative competence.
Construct subject to measurement	At least one component is measured by one or more instruments.	The use of measuring instruments is not reported.

The databases yielded an initial result of 4740 documents. Once the criteria around the type of document, study, period and language were applied, it was reduced to 1816. Subsequently, titles, abstracts, keywords were reviewed and the filters available in the databases were applied to verify the criterion area of knowledge. This led to a preliminary basis of 101 studies. After the above, we read the sections corresponding to the Method to identify the *sample*, Introduction to assess the thematic emphasis and, particularly, the collection techniques used to verify the *construct* criterion *subject to measurement*. From this, a database with 19 articles was consolidated (see Figure 1).

Figure 1. *PRISMA diagram of the search and selection process*
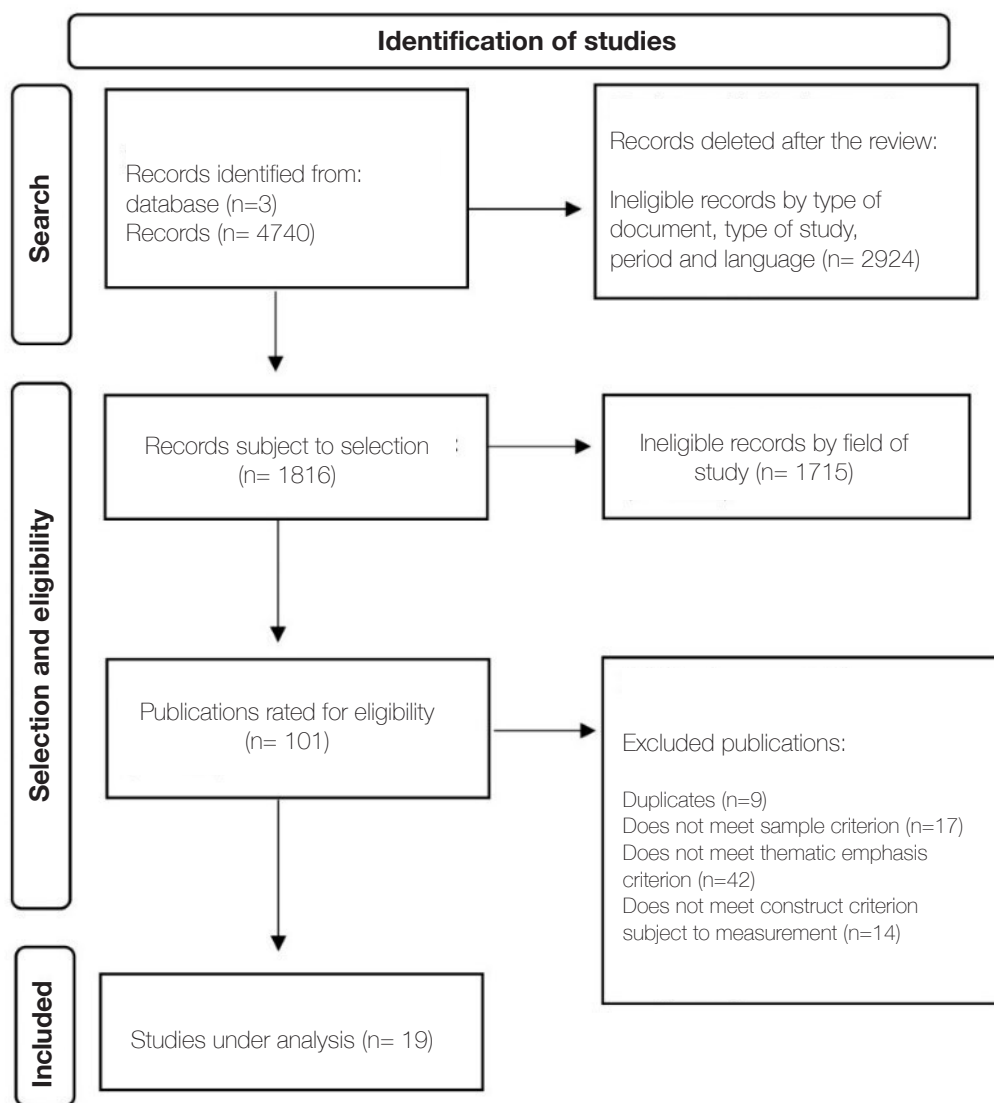
Note. Adapted from Urrútia and Bonfill (2010).

3. Results

The results are organized according to the aspects involved in the design and development of measurement instruments such as: proposed use, target population, conceptualization of the construct, format of the instrument and generation of validity evidence.

3.1 Proposed use

The construction of measuring instruments has been driven by various reasons and purposes. Mainly, they have been developed as resources to report on the degree of acquisition and mastery of the student's knowledge, skills and attitudes in and for the field of educational research (*e.g.* Díaz-Espinoza & Cardoza-Sernaqué, 2021; Gess et al., 2019; Mendioroz et al., 2022; Muşlu-Kaygısız et al., 2018; Reyes-González & García-Cartagena, 2014; Ríos et al., 2023). On the other hand, they have also been built to collect information for evaluations of the effectiveness or incidence of educational programs or strategies aimed at promoting research competence (*e.g.* Carlín-Chávez et al., 2020; Marrs et al., 2022; Su & Long, 2021; Wongdee, 2019). To a lesser extent, these have been used in diagnostic evaluations that have ultimately served as a starting point for developing intervention models or programs (*e.g.* Gómez-Escorcha et al., 2019; Olazábal & Aguila, 2020; Sanabria et al., 2014). The intended purpose of an instrument has an impact on the potential inferences and conclusions that can be drawn from its scores. The clear description of its purposes allows an adequate interpretation of the information obtained, otherwise, there is a risk of distorting these interpretations and arriving at conclusions that the scores or results cannot support (Kane, 1992; 2013). In this sense, clarity and explicit use are indicators of quality of an instrument.

3.2 Target population

Educational research is a field of knowledge and interdisciplinary professional practice enriched by different perspectives on educational phenomena. The findings indicate that the samples are composed of students enrolled in a variety of study programs, differentiated by their curricular and training objectives. On the one hand, there are those who study programs aimed at training professionals in a specific discipline, such as: Pedagogy (*e. g.* Rodríguez et al., 2023), Child Pedagogy (*e. g.* García-Gutiérrez & Aznar-Díaz, 2019), Educational Psychology (*e. g.* Díaz-Espinoza & Cardoza-Sernaqué, 2021; Marrs et al., 2022) or Educational Communication (*e. g.* Juárez and Torres, 2022).

On the other hand, a significant part of the target populations is made up of students who are training as professionals of education, i.e. teaching in a discipline or special school contents, mainly related to primary education (*e.g.* Mendioroz et al., 2022; Núñez-Rojas et al., 2021), mathematics for basic education (*e.g.* Reyes-González & García-Cartagena, 2014; Sanabria et al., 2014) and early childhood education (*e.g.* Mendioroz et al., 2022; Muşlu-Kaygısız et al., 2018). This diversity reflects an interest in obtaining information on the acquisition and development of research competence in students in the educational field. This, in turn, emphasizes the importance of recognizing the traits of both the profession and the training programs according to their purposes, disciplinary conventions, sociocultural context and institutional conditions (Hernández et al., 2019; Martínez-Rizo, 2019) that intervene in the practice of educational research. Table 3 summarizes the findings in relation to the proposed uses and target population expressed by the reported samples.

Table 3. *Proposed uses and target population of the measurement instruments analyzed*

Main Reference	Proposed use	Sample
Carlín-Chávez et al. (2020)	Report on the effectiveness of a didactic strategy focused on research projects for research skills.	n=25 Program: physical education.
Díaz-Espinoza & Cardoza-Sernaqué (2021)	Estimate research capabilities and attitude towards educational research.	n=269 Programs: education administration, education and educational psychology.

Main Reference	Proposed use	Sample
Fuster-Guillén & Santa-María (2020)	Correlate variables of deep thinking, as a component of research competence, with the ability to solve social problems.	n=141 Program: education.
García-Gutiérrez & Aznar-Díaz (2019)	Report on the acquisition and development of research competence.	n=244 Program: children's education.
Gess et al. (2019)	Generate a measure for the evaluation of research competence.	n=138* Program: education.
Gómez-Escorcha et al. (2019)	Diagnose the mastery degree over the knowledge required to formulate a research project.	n=25 Program: educational planning.
Juarez & Torres (2022)	Report on the impact of the training project as a didactic intervention for the development of research competence.	n=58 Programs: educational communication, pedagogy and art education.
Marrs et al. (2022)	Offer a measurement of research competence to assess the quality of training or intervention programs.	n=456 Programs: education, educational psychology and special education.
Mendioroz et al. (2022)	Indicate the student's perceived assessment of their own performance with respect to the research competence.	n=208 Programs: early childhood and primary education.
Muşlu-Kaygısız et al. (2018)	Determine the degree to which students can evaluate and make a judgment on the quality of scientific evidence or literature.	n=947 Programs: science and mathematics teaching in basic education, early childhood education, primary education.
Núñez-Rojas et al. (2021)	Expose the students' perceptions on the promotion of research competence through didactic strategies such as training projects and action research.	n=84 Programs: early childhood, primary and secondary education.
Olazábal & Aguila (2020)	Diagnose the degree of dominance over research competence.	n=33 Program: Teaching foreign language English.
Ravelo-Peña et al. (2019)	Provide a measure to identify the current state of the theoretical-methodological domain that students possess about the process to conduct research.	n=46 Program: education with specialty in pedagogy-psychology.
Reyes-González & García-Cartagena (2014)	Provide a measure of students' abilities to conduct research.	n=19 Programs: teaching in physics, chemistry and mathematics.
Ríos et al. (2023)	Provide a measure of the mastery degree of research competence in students.	n=304 Programs: education.
Rodríguez et al. (2023)	Inform about knowledge, recognition and attitudes towards educational research.	n=952 Program: primary education, early childhood education and pedagogy.
Sanabria et al. (2014)	Offer a measure as an input for the elaboration of a pedagogical intervention model for the promotion of research competence.	n=6 Programs: teaching in social sciences, biology and mathematics.
Su & Long (2021)	Report on the incidence of two didactic strategies, the conceptual map and an online visual resource based on the text, for improvement in the construction and evaluation of arguments.	n=72 Program: teaching for music, physics and literature.
Wongdee (2019)	Indicate the development of research competences from a pedagogical intervention that implements an activity-based learning model.	n=79 Program: industrial education.

* Represents a partial amount of the total sample reported.

3.3 Conceptualization of the construct

There are different approaches in the conceptualization of investigative competence due to its complex nature. This plurality is seen in the components of the competition, where the same aspect can be defined in different ways. Therefore, in this study it was chosen to adhere, as possible, to the definitions and organizing principles established by the authors of the studies analyzed (see table 4). Despite this decision, the analysis revealed patterns that allowed identifying components in which different conceptions of research competence converge. The following stand out:

- *Meta-cognitive and cognitive skills*: include problem analysis, interpretation of findings, understanding of concepts and disciplinary principles, critical, reflective and argumentative thinking (*e.g.* Fuster-Guillén & Santa-María, 2020; Marrs et al., 2022; Mendioroz et al., 2022; Muşlu-Kaygısız et al., 2018; Su & Long, 2021).
- *Methodological knowledge*: refers to the domain of the stages and processes involved in the research process and the methodology in the research (*e.g.* García-Gutiérrez & Aznar-Díaz, 2019; Gess et al., 2019; Gómez-Escorcha et al., 2019; Núñez-Rojas et al., 2021; Olazábal & Aguila, 2020; Ravelo-Peña et al., 2019; Wongdee, 2019).
- *Verbal, written and digital communication*: it involves the ability to share, publish and disseminate the knowledge obtained by research in different formats such as articles, theses or papers (*e.g.* Gómez-Escorcha et al., 2019; Juárez & Torres, 2022; Reyes-González & García-Cartagena, 2014; Ríos et al., 2023; Sanabria et al., 2014).

In addition, other components related to:
- *Feasibility or operability of the research project*: the student's ability to plan and effectively execute a project outside available resource (Carlín-Chávez et al., 2020; Gess et al., 2019).
- *Effective and attitudinal components*: related to the willingness, duties, perceptions and motivations of the student towards research (Díaz-Espinoza & Cardoza-Sernaqué, 2021; Rodríguez et al., 2023).
- *Contextual conditions*: the recognition of the characteristics of the environment and institutional conditions as a fundamental aspect in the elaboration and execution of research projects (García-Gutiérrez & Aznar-Díaz, 2019).

A distinctive component was also observed for students in programs for the training of teaching professionals, which refers to the *application in educational practice* of the results and advances generated through educational research (Gómez-Escorcha et al., 2019; García-Gutiérrez & Aznar-Díaz, 2019; Olazábal & Aguila, 2020). It is important to note that the definitions of the components of research competence, reported in the literature, are usually descriptive and ambiguous. This makes it difficult to identify the relationship between conceptual definition and operational statements, which serve as indicators to be scored or captured by instruments.

Table 4. *Components subject to measurement of investigative competence*

Main Reference	Components
Carlín-Chávez et al. (2020)	Methodology of scientific research, scientific-technological impact, potential results of the proposal, applicability and exposure.
Díaz-Espinoza and Cardoza-Sernaqué (2021)	Cognitive and technological skills, information search, elaboration of theoretical and methodological framework, report of results, bibliographic references, research experience, cognitive, affective and behavioral attitude.
Fuster-Guillén and Santa-María (2020)	Cognitive, communicative, investigative, operational, problem-solving and attitude skills.
García-Gutiérrez and Aznar-Díaz (2019)	Field analysis using observational methodology and information technologies, analysis of the data obtained, understanding of the reality, reporting, linking educational practice and theory, promotion of educational research and innovation, personal and professional development, reading of specialized literature.

Main Reference	Components
Gess et al. (2019)	Mastery of the research process, reflection of one's own practice, methodical and methodological knowledge.
Gómez-Escorcha et al. (2019)	Basic competencies (*e.g.* integrated application of knowledge, skills and abilities to diagnose and interpret reality, know theories and epistemic models), methodological and professional competencies (knowledge and skills for teaching practice).
Juarez and Torres (2022)	Formulation of research problems, raising questions to carry out information searches, selection and evaluation of the relevance and quality of resources, critical analysis of data, socialization of findings; communication skills.
Marrs et al. (2022)	Skills for state-of-the-art development, methodological skills, reflection on findings, communicative skills and content knowledge.
Mendioroz et al. (2022)	Comprehensive (*e.g.* information interpretation), critical (*e.g.* information evaluation), creative (*e.g.* relationship building) and meta-cognitive (*e.g.* decision making) competencies.
Muşlu-Kaygısız et al. (2018)	Scientific thinking.
Núñez-Rojas et al. (2021)	Planning, action, observation, reflection and organization.
Olazábal and Aguila (2020)	Design of pedagogical research, analysis of information based on methodologies in the field of pedagogy, implementation of tasks for solving pedagogical problems, communication of the results.
Ravelo-Peña et al. (2019)	Cognitive dimension (*e.g.* mastery of research content), research activities (*e.g.* reflection and collaborative work) and management of the pedagogical collective from the discipline (*e.g.* planning of research activities).
Reyes-González and García-Cartagena (2014)	Observation skills, processes and scientific communication.
Ríos et al. (2023)	Formulation of the problem approach, theoretical-conceptual framework and state-of-the-art, methodology, communication of the results and evaluation.
Rodríguez et al. (2023)	Willingness and participation in the research, self-assessment, teaching intervention and institutional conditions.
Sanabria et al. (2014)	Technological, meta-cognitive (*e.g.* reflection and learning strategies) and investigative competence.
Su and Long (2021)	Skills for evaluating and constructing arguments.
Wongdee (2019)	Clarity and consistency of the relationship between variables and context, consistent and argued problem approach, objectives consistent with hypotheses and operational definitions of the variables, elaboration of the state-of-the-art or literature review, knowledge about methodology, results consistent with objectives and elaboration of projects in accordance with academic regulations.

3.4 Format of the instrument

The selection of a format for the instrument depends on how the construct has been defined in operational terms, which in turn determines the type of information collected. In other words, decisions about what type of instrument to design and apply condition the scope and way in which the construct subject to measurement is captured. The results show an inclination towards the use of questionnaires to report on the research competence of students (*e.g.* Fuster & Santa-María, 2020; García-Gutiérrez & Aznar-Díaz, 2019; Gómez-Escorcha et al., 2019; Marrs et al., 2022; Mendioroz et al., 2022; Muşlu-Kaygısız et al., 2018; Núñez-Rojas et al., 2021; Reyes-González & García-Cartagena, 201; Ríos et al., 2023; Rodríguez et al., 2023). However, formats such as the observation rubric (Juárez & Torres, 2022), surveys (Olazábal & Aguila, 2020; Ravelo-Peña et al., 2019), knowledge tests and attitudinal scales (*e.g.* Wongdee, 2019) have also been used. In addition, instruments with different administration methods have been used such as the self-assessment scales (Díaz-Espinoza & Cardoza-Sernaqué, 2021; Gess et

al., 2019). Also, formats that operate through the analysis of materials such as protocols to evaluate research projects (Carlín-Chávez et al., 2020) and verbal reports (Sanabria et al., 2014) have been used.

The predominance of the questionnaire follows a tradition in educational measurement that considers numerical scores as main indicators of acquisition, and dominance and performance related to a competition (Ary et al., 2010; Linn, 2010). Against this background, it is important to promote the use of multiple tools to obtain information on components of research competence that could be inaccessible through questionnaires. Examples of this are found in the studies published by Fuster & Santa-María (2020) and Reyes-González & García-Cartagena (2014).

3.5 Generation of evidence of validity

Validity evidence is essential to support the possible interpretations derived from the scores obtained through the measurement instruments. In the studies analyzed, it is common to generate the evidence through empirical analyzes (AERA, APA and NCME, 2018), i.e. through statistical tests. For example, the Cronbach alpha index is commonly reported with values ranging from 0.780 to 0.967 (Díaz-Espinoza & Cardoza-Sernaqué, 2021; Fuster & Santa-María, 2020; García-Gutiérrez & Aznar-Díaz, 2019; Marrs et al., 2022; Mendioroz et al., 2022; Núñez-Rojas et al., 2021; Ríos et al., 2023; Rodríguez et al., 2023); and Kairse-Meyer-Olkin test (KMO), used mainly to verify the adequacy of items to the construct subject to measure or to estimate the relevance of conducting factor analysis, is reported with values in a range of 0.701 to 0.973 (Muşlu et al., 2018; Núñez-Rojas et al., 2021; Ríos et al., 2023). In some studies, agreement indices between experts or judges are used to provide evidence of content validity with values between 0.80 and 0.950 (Su & Long, 2021; Wongdee, 2019).

It is important to note that in some cases no evidence of validity is reported (Carlín-Chávez et al., 2020; Gómez-Escorcha et al., 2019; Juárez & Torres, 2022; Olazábal & Aguila, 2020; Ravelo-Peña et al., 2019; Reyes-González & García-Cartagena, 2014; Sanabria et al., 2014) which underlines the importance of properly documenting the psychometric properties of the instruments used.

Analysis of this aspect suggests a traditional approach to validation focused on obtaining numerical values through indices, coefficients and other statistical tests as the only argument that the scores obtained allow to make informed inferences. However, a distinctive case is the work of Gess et al. (2019) where a validation process is conducted from an argumentative approach. In this case, the authors make assumptions such as: 1) the scale reflects the research competence in the social sciences, distinguishing it from the natural sciences, 2) the scores account for the student's performance, or 3) the scale is applicable to students of various disciplines within the social sciences (*e.g.* educational sciences or sociology). From this, they perform empirical and logical analyses to generate evidence of validity that supports these assumptions and, therefore, the use of the results of the instrument.

4. Discussion and conclusions

Research from the Educational Evaluation has highlighted the inherent complexity of determining how to obtain measures or values that accurately reflect the acquisition and performance of the competences acquired by university students. Therefore, the development of measurement tools requires both careful planning and systematic procedures if the results are to be used effectively in decision-making. The objective of the study was to examine the instruments used to inform research competence in the educational field of university students. The analysis focused on the main aspects involved in its design and development, such as: proposed use, target population, conceptualization of the construct, format of the instrument and generation of validity evidence.

During the last decade (2013-2023), the development of tools has focused mainly on the following objectives: 1) reporting on the degree to which students have acquired and developed the various components that make up research competence; 2) providing information based on which to assess the effectiveness of pedagogical interventions aimed at promoting such competence; and 3) providing data for diagnostic evaluations. The intended use of a measurement instrument is not limited to simply stating its purposes and purposes, it's clear and explicit definition delimits the inferences, conclusions and decisions that its results can support, linking

directly with the generation of validity evidence (Hattie & Leeson, 2013; Kane, 1992; 2013).

Given the traits of educational research in terms of its theoretical perspectives, methodological resources and academic conventions, the evaluation of research competence in this area requires instruments sensitive to these distinctions. During the selection process in the systematic review, a significant reduction of articles that met the *field of study* criterion was observed, aimed at identifying those investigations that explicitly referred to disciplines with an educational approach. The latter agrees with the findings presented by Sandoval-Henríquez & Sáez-Delgado (2023), where it is highlighted that academic production on the topic of interest concentrates in the health (*e.g.* medicine and nursing) and natural sciences (*e.g.* physics, biology and chemistry).

On the other hand, it is important to distinguish between the training of professionals in a discipline with an educational focus (*e.g.* educational psychology or pedagogy) and the training of professionals for initial teacher education or training. While each one is framed in training projects with curricular objectives and demands both professional and different social (Martínez-Rizo, 2019; Villa, 2005). In this sense, the selection of the students that make up the target population must be carried out carefully to develop instruments sensitive to these distinctions and provide coherent information on the achievement of research competence.

As this competence is a complex and multi-factorial construct, its definition represents a challenge for Educational Evaluation. Despite this, the findings highlight a certain structural uniformity in the conceptualization of the construct, i.e., of the investigative competence in and for the educational field. The components and indicators follow a common organization according to meta-cognitive, cognitive, methodological dimensions, as well as aspects related to communication, viability and operability, affective-attitudinal attributes and contextual conditions where research is practiced. These dimensions or categories are in line with those established in the specialized literature (Ciras-Calí et al., 2022; Colás-Bravo and Hernández, 2021; Espinoza et al., 2016; Martínez-Rizo, 2019; Sandoval-Henríquez & Sáez-Delgado, 2023).

On the other hand, it is important to note that in most of the studies analyzed the definitions are usually presented from a descriptive level and often the operational definitions of each component subject to measurement are absent. This lack of clarity limits the discussion about the meaning given to research competence and how to measure its different components, as well as it hinders collaborative, cumulative and consistent work among the academic community.

The diversity of definitions of research competence leads to a variety of possible formats for measurement instruments. Although the questionnaire is the commonly used format, others were also identified as the rubric of observation, tests, attitudinal and self-assessment scales, evaluation protocols of thesis projects or verbal reports. In the selection of one or the other format, its scope and limitations should be considered when reporting on a specific component of the investigative competence. Thus, it is necessary to assess the relevance of the format according to the proposed uses and the type of information that each one offers (Ary et al., 2010; AERA, APA & NCME, 2018; Naglieri, 2013). In addition, the use of multiple formats can be promoted to capture more fully a complex competence such as research (Fuster & Santa-María, 2020; Reyes-González & García-Cartagena, 2014).

Finally, the procedures to generate evidence of validity have been carried out from a traditional approach. The notion of validity in the analyzed studies refers mainly to a property of the instrument that is verified by obtaining a numerical value through statistical tools. These values are considered as the only argument to support the results of the instrument. However, the study conducted by Gess et al. (2019) who carried out the validation from an argumentative approach stands out.

Therefore, it is suggested to generate evidence of validity from the argumentative approach. This involves using various sources of information and analysis strategies to obtain consistent and coherent evidence that bases both the components of research competence subject to measurement and the possible uses and interpretations of the results obtained by the instrument (AERA, APA & NCME, 2018; Kane, 2013; Ramos, 2015).

This study highlights the need for deeper analysis on both conceptual and operational definitions of research competence, as well as its distinctive features in the training of professionals in disciplines

with educational orientation and in the training for teaching professionals. It also underlines the importance of reviewing procedures to obtain more comprehensive evidence of validity.

References

American Educational Research Association, American Psychological Association, y National Council on Measurement in Education. [AERA, APA y NCME]. (2018). *Estándares para pruebas educativas y psicológicas* (M. Lieve, Trans.). American Educational Research Association.

Ary, D., Jacobs, L. C., Sorensen, C. & Razaviech, A. (2010). *Introduction to Research in Education* (8th Edition). Wadsworth Cengage Learning.

Boritz, J. E. & Carnaghan, C. A. (2003). Competency-based education and assessment for the accounting profession: a critical review. *Canadian Accounting Perspectives*, *2*(1), (7-42). https://doi.org/10.1506/5K7C-YT1H-0G32-90K0

Cardoza, M., Montenegro, L., Collazos, M. A., García, V. A., Bellido, O. & Turriate, J. J. (2023). Development of research competences in university professors: A bibliographic review. *International Journal of Membrane Science and Technology*, *10*(3), 1750-1755. https://doi.org/10.15379/ijmst.v10i3.1790

Carlín-Chávez, E., Carballosa-González, A. & Herrera-Rivas, K. (2020). Formación de competencias investigativas de los estudiantes en la Universidad de Guayaquil. *Revista Universidad y Sociedad*, *12*(2), 8-16. https://bit.ly/3PyPz6c

Castillo-Martínez I. M. & Ramírez-Montoya, M. S. (2021). Research competencies to develop academic reading and writing: a systematic literature review. *Frontiers in Education*, *5*. https://doi.org/10.3389/feduc.2020.576961

Chen, Q., Huang, C., Castro, A. & Tang, S. (2021). Instruments for measuring nursing research competence: a protocol for scoping review. *BMJ Open*, *11*(2). https://doi.org/10.1136/bmjopen-2020-042325

Ciraso-Calí, A., Martínez-Fernández, J. R., París-Mañas, G., Sánchez-Martí, A. & García-Ravidá, L. B. (2022). The research competence: acquisition and development among undergraduates in education sciences. *Frontiers in Education*, *7*. https://doi.org/10.3389/feduc.2022.836165

Colás-Bravo, P. & Hernández, M. Á. (2021). Las competencias investigadoras en la formación universitaria. *Revista Universidad y Sociedad*, *13*(1), 17-25. https://bit.ly/3x6rvkT

Díaz-Espinoza, M. & Cardoza-Sernaqué, M. (2021). Habilidades y actitudes investigativas en estudiantes de maestría en educación. *Revista Venezolana de Gerencia*, *26*(e6), 410-425. https://doi.org/10.52080/rvgluz.26.e6.25

Downing, S. M. (2006). Twelve steps for effective test development. En S. M. Downing y T. M. Haladyna (Eds.), *Handbook of test development* (pp. 3-25). Lawrence Erlbaum Associates.

Downing, S. M. & Haladyna, T. M. (2011). *Handbook of test development*. Lawrence Erlbaum Associates.

Espinoza, E., Rivera, A. & Tinoco, N. (2016). Formación de competencias investigativas en los estudiantes universitarios. *Atenas*, *1*(33). https://bit.ly/3IQwAjD

Estrada, O. (2014). Sistematización teórica sobre la competencia investigativa. *Revista Electrónica Educare*, *18*(2), 177-194. http://dx.doi.org/10.15359/ree.18-2.9

Fuster-Guillén, D. & Santa-María, H. (2020). New functional model of research skills in social problem solving. *International Journal of Early Childhood Special Education*, *12*(1), 442-451. https://doi.org/10.9756/INT-JECSE/V12I1.201024

García-Cabrero, B., y Ledesma, A. (2022). La evaluación de competencias en educación superior: enfoques tradicionales y estrategias innovadoras. En M. Sánchez-Mendiola y A. Martínez-González (eds.), *Evaluación y aprendizaje en educación universitaria: estrategias e instrumentos* (pp. 605-619). CUAIEED.

García-Gutiérrez, Z. & Aznar-Díaz, I. (2019). El desarrollo de competencias investigativas, una alternativa para formar profesionales pedagogía infantil como personal docente investigador. *Revista Electrónica Educare*, *23*(1). https://doi.org/10.15359/ree.23-1.15

Geisinger, K. F., Bracken, B. A., Carlson, J. K., Hansen, J. C., Kuncel, N. R., Reise, S. P. & Rodriguez M. C. (2013). *APA handbook of testing and assessment in psychology, Vol. 3: testing and assessment in school psychology and education*. APA.

Gess, C., Geiger, C. & Ziegler, M. (2019). Social-scientific research competency validation for test score interpretations for evaluative purposes in higher education. *European Journal of Psychological Assessment*, *35*(5), 737-750. https://doi.org/10.1027/1015-5759/a000451

Gómez-Escorcha, J., Isea, N. & López, V. (2019). Competencias investigativas y su influencia en la formulación de proyectos de investigación en la Universidad Valle del Momboy. *Actualidades Pedagógicas*, *1*(74), 191-213.

https://doi.org/10.19052/ap.vol1.iss74.10

Hattie, J., y Leeson, H. (2013). Future directions in assessment and testing in education and psychology. En K. F. Geisinger, B. A. Bracken, J. F. Carlson, J. C. Hansen, N. R. Kuncel, S. P. Reise y M. C. Rodriguez (eds.), *APA handbook of testing and assessment in psychology, Vol. 3: testing and assessment in school psychology and education* (pp. 391-414). APA.

Hernández, M. I., Patricia, A., Daher, J. & Royero, M. (2019). Las competencias investigativas en la Educación Superior. &*achana Revista Científica*, *8*(3), 71-80.
https://doi.org/10.62325/10.62325/yachana.v8.n3.2019.610

Ianni, P., Samuels, E., Eakin, B., Perorazio, T. Ellingrod, V. (2019). Assessments of research competencies for clinical investigators: a systematic review. *Evaluation and the Health Professions*, *44*(3), 268-278. https://doi.org/10.1177/0163278719896

Jornet, J., González, J., Suárez, J. & Perales, J. (2011). Diseño de procesos de evaluación de competencias: consideraciones acerca de los estándares en el dominio de las competencias. *Bordón. Revista de Pedagogía*, *63*(1), 125-145.
https://bit.ly/3vzXtVY

Jornet, J., Perales, M. & González-Such, J. (2020). El concepto de validez de los procesos de evaluación de la docencia. *Revista Española de Pedagogía*, *78*(276), 233-252.
https://doi.org/10.22550/REP78-2-2020-01

Juárez. D. & Torres, C. (2022). La competencia investigativa básica. Una estrategia didáctica para la era digital. *Sinéctica, Revista Electrónica de Educación*, (58), e1302.
https://doi.org/10.31391/S2007-7033(2022)0058-003

Kane, M. (1992). An argument-based approach to validation. *Psychological Bulletin*, *112*(3), 527-535.
https://doi.org/10.1037/0033-2909.112.3.527

Kane, M. (2013). Validating the interpretations and Uses of Test Scores. *Journal of Educational Measurement*, *50*(1), 1-73. https://doi.org/10.1111/jedm.12000

Lane, S., Raymon, M. R. & Haladyna, T. M. (2016). *Handbook of test development* (2nd Edition). Routledge.

Lane, S., Raymond, M. R., Haladyna, T. M. & Downing, S. M. (2016b). Test development process. En S. Lane, M. R. Raymond y T. M. Haladyna (eds.), *Handbook of Test Development* (2nd Edition) (pp. 3-18). Routledge.

Linn, R. L. (2010). Educational measurement: overview. En P. Peterson, E. Baker y B. McGaw (eds.), *International Encyclopedia of Education* (pp. 45-49). Elsevier.

Manzanares, A. & Sánchez-Santamaría, J. (2016). La dimensión pedagógica de la evaluación por competencias y la promoción del desarrollo profesional en el estudiante universitario. *Revista Iberoamericana de Evaluación Educativa*, *5*(1e), 187-202.
https://doi.org/10.15366/riee2012.5.1.013

Marrs, S., Quesada-Pallarés, C., Nicolai, K., Severson-Irby, E. & Martínez-Fernández, J. (2022). Measuring perceived research competence of junior researchers. *Frontiers in Psychology*, *13*.
https://doi.org/10.3389/fpsyg.2022.834843

Martínez-Rizo, F. (2019). *El nuevo oficio del investigador educativo. Una introducción metodológica.* UAA: COMIE.

Mejía, O. (2012). De la evaluación tradicional a una nueva evaluación basada en competencias. *Revista Electrónica Educare*, *16*(1), (27-46).
http://doi.org/10.15359/ree.16-1.3

Mellado-Moreno, P., Sánchez-Antolín, P. & Blanco-García, M. (2021). Tendencias de la evaluación formativa y sumativa del alumnado en Web of Sciencies. *Alteridad Revista de Educación*, *16*(2), 170-183.
https://doi.org/10.17163/alt.v16n2.2021.01

Mendioroz, A., Napal, M. & Peñalva, A. (2022). La competencia investigativa del profesorado en formación: percepciones y desempeño. *Revista Electrónica de Investigación Educativa*, *24*, e28.
https://doi.org/10.24320/redie.2022.24.e28.4182

Moreno-Olivos, T. (2021). Cambiar la evaluación: un imperativo en tiempos de incertidumbre. *Alteridad Revista de Educación*, *16*(2), 223-234.
https://doi.org/10.17163/alt.v16n2.2021.05

Muşlu-Kaygısız, G., Gürkan, B. & Akbaş, U. (2018). Adaptation of scientific reasoning scale into Turkish and examination of its psychometric properties. *Educational Sciences: Theory & Practice*, *18*, 737-757.
http://dx.doi.org/10.12738/estp.2018.3.0175

Naglieri, J. A. (2013). Psychological assessment by school psychologists: opportunities and challenges of a changing landscape. En K. F. Geisinger, B. A. Bracken, J. F. Carlson, J. C. Hanse, N. R. Kuncel, S. P. Reise y M. C., Rodriguez (eds.), *APA handbook of testing and assessment in psychology, Vol. 3. Testing and assessment in school psychology and education* (pp. 3-19). APA.
https://doi.org/10.1037/14049-000

Núñez-Rojas, N., Chanduví-Calderón, W., Ballena-de-la-Cruz, A. & Ayala-Tandazo, J. (2021). Proyectos formativos y de investigación-acción como estrategias didácticas en la formación de docentes

peruanos. *Revista de Ciencias Sociales*, *27*(e4), 364-378. https://doi.org/10.31876/rcs.v27i.37013

Olazábal, G. & Aguila, A. (2020). Formación de la competencia investigativa en los estudiantes de la carrera Licenciatura en Educación Lengua Extranjera. *Mendive, Revista de Educación*, *18*(3), 515-527. https://bit.ly/43AbIqr

Paterson, B. (2012). It looks great but how do I know if it fits? An introduction to meta-synthesis research. En K. Hannes y C. Lockwood (eds.), *Synthesizing qualitative research: choosing the right approach* (pp. 1-20). Wiley-Blackwell.

Paz, C. L. & Estrada, L. (2022). Condiciones pedagógicas y desafíos para el desarrollo de competencias investigativas. *Revista Electrónica de Investigación Educativa*, *24*(e09), 1-17.
https://doi.org/10.24320/redie.2022.24.e09.3937

Ramos, A. (2015). La validez en los exámenes de alto impacto. Un enfoque desde la lógica argumentativa. *Perfiles Educativos*, *37*(149), 169-186.
https://doi.org/10.22201/iisue.24486167e.2015.149.53132

Ravelo-Peña, M., Bonilla-Vichot, I., Martell-Socorras, M. & Toledo-González, M. (2019). La formación y desarrollo de la competencia investigativa, una experiencia en Pinar del Río. *Mendive, Revista de Educación*, *17*(1), 54-68. https://bit.ly/3IOZgcP

Reyes-González, D. & García-Cartagena., Y. (2014). Desarrollo de habilidades científicas en la formación inicial de profesores de ciencias y matemáticas. *Educación y Educadores*, *17*(2), 271-285. https://doi.org/10.5294/edu.2014.17.2.4

Ríos, P., Ruiz, C., Paulos, T. & León, R. (2023). Desarrollo de una escala para medir competencias investigativas en docentes y estudiantes universitarios. *Areté, Revista Digital del Doctorado en Educación*, *9*(17), 147-169.
https://doi.org/10.55560/arete.2023.17.9.7

Rodríguez, A., Caurcel, M. J., Gallardo, C. & García, A. (2023). Reconocimiento y actitud hacia la investigación educativa en la universidad. *Revisa Interuniversitaria de Formación del Profesorado*, *98*(37.1), 139-158.
https://doi.org/10.47553/rifop.v98i37.1.97824

Sanabria, L., López, O. & Leal, L. (2014). Desarrollo de competencias metacognitivas e investigativas en docentes en formación mediante la incorpora-ción de tecnologías digitales: aportes a la excelencia docente. *Revista Colombiana de Educación*, (67), 147-170.
https://doi.org/10.17227/0120391.67rce147.170

Sandelowski, M. & Barroso, J. (2007). *Handbook for Synthesizing Qualitative Research*. Springer.

Sandoval-Henríquez, F. & Sáez-Delgado, F. (2023). Revisión sistemática sobre competencias de investigación en estudiantes de educación superior. *Páginas de Educación*, *16*(2), 186-211.
https://doi.org/10.22235/pe.v16i2.3340

Su, G. & Long, T. (2021). Is the text-based cognitive tool more effective than the concept map on improving the pre-service teachers' argumentation skills? *Thinking Skills and Creativity*, *41*.
https://doi.org/10.1016/j.tsc.2021.100862

Urrútia, G. & Bonfill, X. (2010). Declaración PRISMA: una propuesta para mejorar la publicación de revisiones sistemáticas y metaanálisis. *Medicina Clinica*, *135*(11), 207-511.
https://doi.org/10.1016/j.medcli.2010.01.015

Valderrama, M. W., Pérez, C. L., Llaque, G. I. & Matute, J. C. (2022). *Habilidades investigativas en estudiantes universitarios. Una revisión sistemática* [Conferencia]. 20th LACCEI International Multi-conference for Engineering, Education and Technology: education, research and leadership in post-pandemic engineering: resilient, inclusive and sustainable actions. Florida, Estados Unidos.
http://dx.doi.org/10.18687/LACCEI2022.1.1.127

Valdiviezo-Villegas, G. & Leyva-Aguilar, N. (2023). Development of research competence in education: systematic review of literature. *Russian Law Journal*, *11*(4). https://bit.ly/3VzSejN

Villa, L. (2005). La delimitación y validez de la investigación educativa. En P. G. Rodríguez (ed.), *Linderos. Diálogos sobre investigación educativa* (pp. 239-245). COMIE: CEE: SEB: ITESO

Wongdee, P. (2019). The development of activity-based learning model to enhance research skills for pre-service teachers of industrial education, faculty of industrial education and technology, Kmutt. *Humanities, Arts and Social Studies*, *19*(1), 182-220. https://doi.org/10.14456/hasss.2019.9