

EVALUATION OF RESEARCH SKILLS AT A MEXICAN PUBLIC UNIVERSITY

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Abstract: The study investigated the initial level of research competence among students newly enrolled in a Mexican public university. The validated questionnaire of 39 items organized into five parts: theoretical foundation, research attitude, cognition, procedural skills, and scientific communication, identified that the data from these cohorts of students have strong conceptual foundations and desire to do scientific work. However, the following weaknesses were noted in relation to problem formulation, use of statistical methods, and, particularly, socialization and linking of knowledge to academic spheres. The reason behind this gap lies in the dispersion of theoretical training from its practical application. In general, it is recommended that the content of the program not only be renewed in terms of experience and ways of collaborating, but that competencies be integrated in a more sustained and systemic manner.

Keywords: research skills, higher education, assessment, formative research, public university.

Abstract: The study investigated the initial level of research competence among students newly enrolled in a Mexican public university. The validated questionnaire, consisting of 39 items organized into five parts: theoretical foundation, research attitude, cognition, procedural skills, and scientific communication, identified that the data from these cohorts of students have strong conceptual foundations and desire to do scientific work. However, the following weaknesses were noted in relation to problem formulation, use of statistical methods and, in particular, socialisation and linking of knowledge to academic spheres. The reason behind this gap lies in the dispersion of theoretical training from its practical application. In general, it is recommended that the programme content be renewed not only in terms of experience and ways of collaborating, but also that skills be integrated in a more sustained and systemic manner.

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INTRODUCTION

Concept

Oropeza et al. (2013) and Farfán and Reyes (2024) define it as a complex construct that integrates cognitive knowledge (epistemic and methodological), procedural skills (collection and analysis techniques), and investigative attitudes (curiosity, rigor, ethics). From a socio-formative perspective, competence is expressed when the subject mobilizes these resources to solve original problems and socializes the findings.

Based on these considerations, it follows that research competencies have emerged as a new category that must be taken into account in higher education (Reiban et al., 2017). The concept of competency refers to an individual's ability to mobilize a set of knowledge, skills, attitudes, and values that enable them to perform adequately in specific contexts (Mendoza, 2008). In the educational field, research competencies are understood as the skills required to carry out successful research. These competencies include learning research techniques, the critical ability to evaluate information, problem solving, and contributing knowledge to a specific field of study (Castro, 2020).

Previous International Research

Reyes et al. (2024) conducted a study aimed at establishing the impact of cooperative work on strengthening inquiry skills in early childhood education students at ISPO Otuzco in 2023. To achieve this goal, an applied pre-experimental design was used, working with a population of 48 students specializing in early childhood education. Surveys and questionnaires were used as data collection tools, and descriptive statistics, table mediations, and figures were also used. SPSS and Excel software were used for information processing and analysis. The results obtained appear to be contradictory, as initially it is indicated that the null hypothesis is accepted, that is, collaborative work does not influence research skills. However, when performing the Wilcoxon statistical test, a value of $Z=-6.637$ was obtained, which the authors consider to indicate that there is a significant influence of collaborative work on the development of skills.

In their study, Ríos Cabrera et al. (2023) contributed to the development of research skills through a socioconstructivist pedagogical approach applied to an international diploma course. The study involved 23 Latin American university professionals. In accordance with the study design proposed in the authors' articles, there was a combination of self-assessment scales, focus groups, rubrics, and evaluation questionnaires. The results indicate that the most relevant finding is the effectiveness and efficiency of the socioconstructivist approach in the development of research skills. Teacher mediation for the integration of theory and practice and working with digital technologies for active and collaborative learning are the areas with the highest incidence.

Girón Márquez (2021) conducted a documentary review of this work with the aim of characterizing the theoretical foundations of the development of research competence in higher education and its applicability in the micro-curriculum. The documentary review was used to describe the definition, development, importance, and approach to research competence in higher education. Finally, the research determines that teachers, through the micro-curriculum, have a direct impact on the teaching-learning process and can contribute significantly to comprehensive training and the improvement of institutional quality through the development of research skills.

Previous Research in Mexico

Rodríguez (2022) conducted a large-scale quantitative study to determine and describe the assessment techniques that teachers use in the modern educational environment. Specifically, 334,817 questionnaires were administered. The data show that the most common assessment strategies are research essays, with 85.8 points, and written essays, with 80.3 points. However, there was very little use of formative assessment tools, especially rubrics, which had an average score of 58.5 points, and checklists, with 58.1 points, which are key to assessing learning in a procedural manner.

Cardoso & Cerecedo (2019) conducted research based on the need to propose an integrated research skills model and the reviewed literature, identifying the following study. The authors conducted a quantitative study representing a sample of 124 university students, with the aim of identifying the four systemic dimensions related to research competencies. Thus, according to the data obtained, a systemic lack of critical components of the research process was demonstrated: methodological design and management for dissemination, which were classified as insufficient; satisfactory personal competencies.

On the other hand, Corona et al. (2024) conducted a mixed longitudinal study at the University of Bajío, systematically monitoring 151 research methodology students in order to evaluate the development and retention of research skills. Methodological mastery was one of the areas that underwent the greatest development, given that it presented a pre-post mean difference of 0.67, with a statistical significance level of $p < 0.05$.

Measuring instruments validated in Mexico

Authors	Instrument	Target population	No. of items	Dimensions	Cronbach's alpha	Key descriptive evidence
Jaik and Ortega (2017)	Research Methodological Competence Assessment Scale (EECMI)	Graduate	36	4 factors (construction, statistics, tasks, linguistics)	0.93	Factor analysis confirms homogeneous structure
Rodríguez et al. (2022)	Analytical Rubric Matrix for Clinical Case Presentations Clinical	Medicine	18	Argumentation, design, synthesis	0.9	Encourages formative feedback and co-evaluation
Corona et al. (2024).	Longitudinal Questionnaire on Research Competencies (CLCI)	Engineering and social sciences	30	Methodological, oral, written, ethics	0.88	Demonstrates stability of skills one year later

The first instrument was carried out through a study that validated the Research Methodological Competence Assessment Scale (EECMI), which is an instrument created to test the level of knowledge, abilities, and skills necessary during research processes for educational purposes. Instrumental studies were carried out by applying the psychometric properties of the tool to a total of 583 postgraduates in Durango, with the help of various mathematical models. These studies confirmed that the tool has high reliability and has been tested for validity, so I can affirm that the tool has been validated and can be successfully applied.

The second was conducted at a Mexican public university, where the authors studied teacher evaluation methods in 334,817 student survey questionnaires. The main findings suggest that student evaluations are driven by traditional approaches and largely assess, for example, research work and supervised exams, while there is little use of more formative instruments, such as rubrics or exercise checklists. Based on these findings, it can be concluded that traditional theoretical approaches and more formative assessment methods coexist in the teaching evaluation of university students. Third, a study conducted with Mexican higher education students resulted in greater development of methodological research skills but deficiencies in oral and written communication. It was conducted with 151 participants in a mixed modality, and the results showed that one year after the intervention, the students maintained their skills. The approach proved effective in evaluating research-based learning, but communication skills need to be strengthened and systematic monitoring of student progress is necessary.

DEVELOPMENT

Research paradigm

For all of the above reasons, it is worth considering the positivist paradigm. This involves an empirical-analytical approach and, above all, a primary association with the quantification of observable phenomena. If the theoretical framework is based on objectivity, verifiability, and generalization, the paradigm can competently address research skills. After all, in their presentation, research competencies lead students to a level of systemic and replicable knowledge. In general, contemporary models of research practices are based on strict and verifiable epistemological approaches.

It should be noted that, in the case of research skills in Mexican public universities, the positivist paradigm results in objective criteria for measurement and comparison. According to Buendía et al. (2018), with its help, it is possible to determine the level of research competence of students in a standardized way. Therefore, the positivist paradigm in educational research is at the heart of theoretical and methodological approaches to the development of research competence in teachers and students.

Level of research

The research is descriptive-evaluative in nature, aimed at systematically characterizing research skills and assessing them in the specific university context. For Perozo et al. (2012), descriptive research provides teacher-researchers with multiple approaches and methodological possibilities with a view to conducting educational research that contributes to the knowledge, analysis, evaluation, understanding, and optimization of the realities identified in the field of institutional evaluative culture.

However, the justification for the evaluative component of this study lies in the need to make value judgments about the degree of development achieved based on appropriately validated criteria and measurement tools, as referred to by Ríos et al. (2023) refer to, in which the construction of scales on a psychological construct vital for the training of teachers and university students, such as research skills, which are exceptionally complex, necessarily requires a particular methodological logic that articulates systematic description and rigorous evaluation, since, ultimately, the artifacts should not be limited to describing a state, but should allow for the quantification of possible frames of reference and evolution. Finally, this level of research not only describes the current state of research skills, but also provides elements for their continuous improvement through systematic evaluation and constructive feedback.

Study design

In terms of research design, this study is non-experimental, descriptive, and cross-sectional, as it measures competence at a specific point in time and does not manipulate variables. As established by Amurrio (2021), this type of design also requires consideration of the different categories of the competency-based approach, i.e., program objectives, curriculum, student outcomes

, teacher training tasks, and entry and exit profiles, must be defined according to the specific educational contexts of each institution.

The methodological structure is organized as follows, based on systematic phases: (1) Diagnosis of the current state of research competencies using previously validated measurement instruments, (2) Comparative analysis of the results reviewed based on specific demographic and academic variables, and (3) Interpretation of the results as inputs for developing recommendations for institutional improvement.

The next step, the cross-sectional design, is justified by "the need to have a clear 'snapshot' of the current state of research skills among the student population," which establishes an empirical framework on which to work and in which to carry out future interventions and longitudinal studies with these same groups of students, as noted by Ríos et al. (2023). It is noted that the design tables enable a comprehensive analysis of the data obtained and subsequent evidence-based institutional decision-making.

Sampling and participants

The sampling of the questionnaires was stratified, while that of direct observation was systematic. The number of participants was 30 first-semester students. For the critical points of attention identified in the exploratory phase, measurements were collected over ten days, spread evenly.

Instrument

The tool developed by Balbo et al. (2015) was adapted. The instrument consists of 39 questions, which can be answered with four options: a) always, b) sometimes, c) almost never, and d) never. The questionnaire has 39 questions divided into five dimensions.

Procedure

The research was structured around four main activities that allowed for the systematic evaluation of research skills in the selected student population.

Activity 1: Selection and Contact with Participants

The identification and recruitment process consisted of official communication through academic coordinators to first-semester students. In addition, the activity included a presentation of the research purpose, an explanation of the participation criteria, and the signing of the informed consent form. Regarding the selection process, stratified sample representativeness was implemented so that the students would reach the student body of

different academic programs in the target student universe. Initial communication as the ethical basis of the study, which clarified the voluntary nature of the study.

Activity 2: Application of the Measurement Instrument

The questionnaire adapted from Balbo et al. (2015) was administered in sessions scheduled during regular class hours, with each application lasting approximately 45 minutes. The instrument consists of 39 multiple-choice questions distributed across five competency dimensions. It was administered in person to ensure proper understanding of each item and with methodological support from the researcher to resolve any conceptual questions that arose without suggesting possible answers, thus guaranteeing the objectivity necessary for the validity of the data.

Activity 3: Systematization and Coding of Data

To this end, the data obtained were organized using a coding matrix, through which numerical values were assigned to the response options of the instrument, with the values being always 4, sometimes 3, almost never 2, and never 1. It includes activities aimed at verifying the completeness of questionnaires, identifying inconsistent responses, cleaning up the database, and others. The purpose of this process was to ensure the integrity of the information collected in order to establish the necessary conditions for subsequent statistical analysis of each of the specific aspects of the competency dimensions evaluated.

Activity 4: Statistical Analysis and Interpretation of Results

With regard to the statistical processing of the data, measures of central tendency and dispersion were used, in addition to comparative analyses between the dimensions of the investigative competencies. The above activity involved frequency tables, weighted averages by dimension, and identification of significant patterns regarding the subjects' competency development. Likewise, once the analysis was completed, the interpretation of the results was carefully reviewed, contextualizing each of the findings to the institution and the academic profile of its students, which allowed us to lay the empirical foundations for the emerging conclusions and recommendations.

DISCUSSION AND ANALYSIS OF RESULTS

This section presents the findings of the study. Figure 1 represents dimension 1.

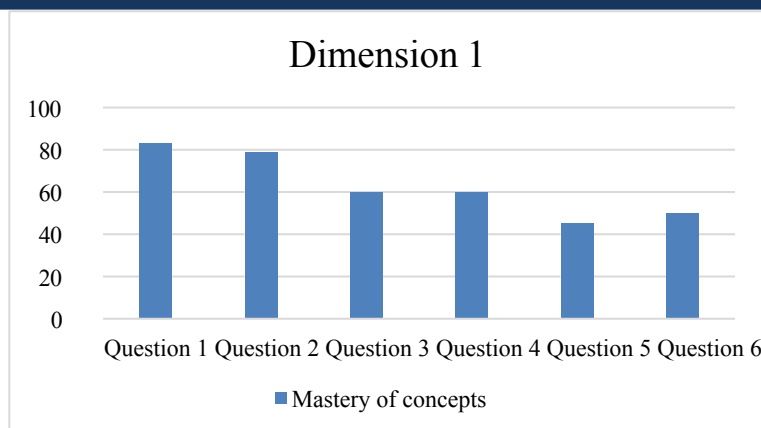


Figure 1. Results for dimension 1.

This dimension shows that students demonstrate a solid conceptual understanding of the theoretical foundations of research. In summary, the results suggest that understanding of concepts such as science, technique, research, and methods is maintained, indicating that basic theoretical training is adequate. However, there is some variability in terms of the depth of this knowledge. While some students seem to have mastered these concepts, others seem to have only a superficial or limited understanding.

Figure 2 shows the results for dimension 2.

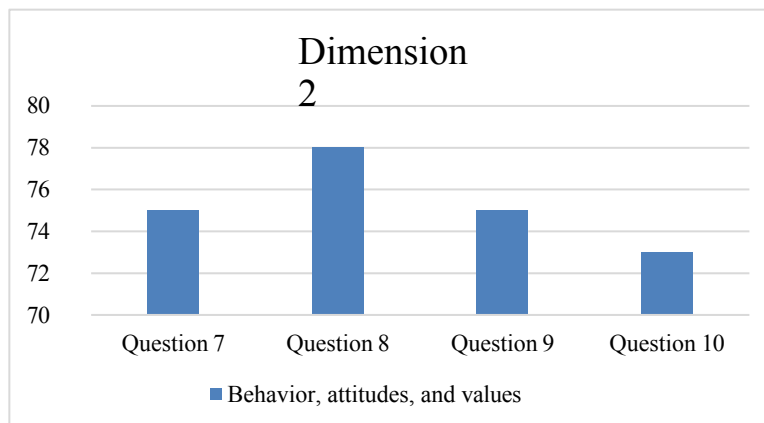


Figure 2. Results for dimension 2.

In general, this dimension shows an encouraging picture of favorable predispositions on the part of students toward three essential characteristics of researchers: open-mindedness, critical thinking, and exploratory potential. The data show a positive assessment of popular knowledge and an open attitude toward constructive criticism. However, the distribution of responses suggests that, while some

students have fully developed highly sophisticated reasoning around these elements, others are still in the process of consolidating a truly scientific and reflective mindset about science and research.

Figure 3 shows the results for dimension 3.

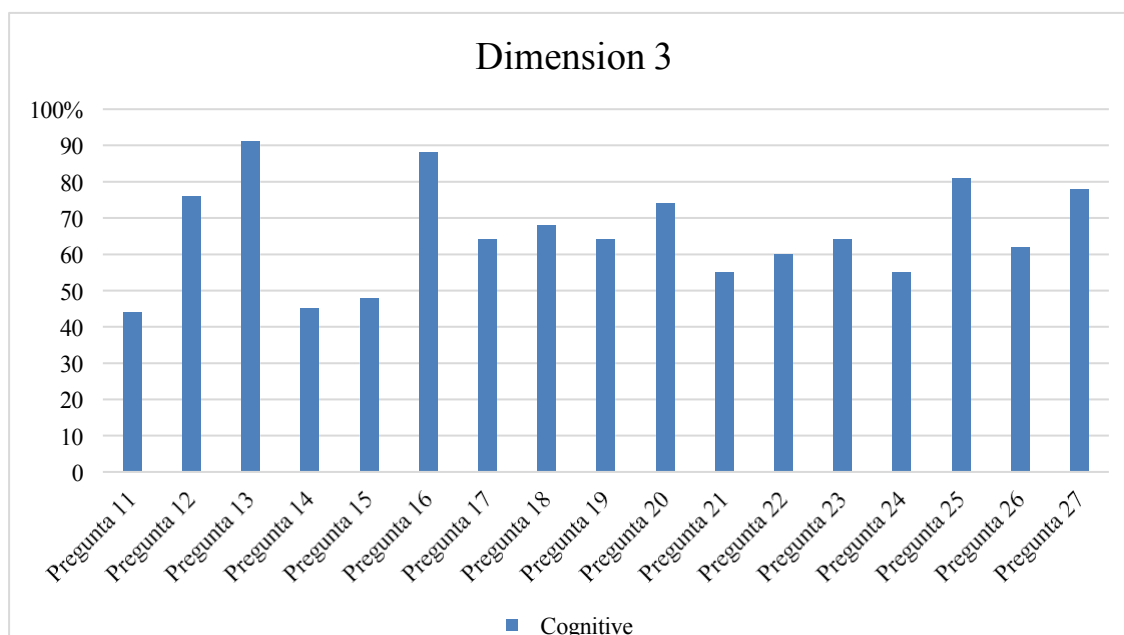


Figure 3. Results of dimension 3.

It can be concluded from the cognitive dimensions that the profile produced is more mixed, revealing particular strengths and weaknesses in the process of building research knowledge. On the one hand, bibliographic competence and recognition of the diversity of research types reveal basic competencies, and we can affirm that the student body has solid skills in this regard. On the other hand, problems associated with activities that require greater intellectual precision, such as the clear and direct formulation of the research problem, the consistent production of the theoretical framework, or the adequate drafting of objectives, show that it is still a challenge for students to combine conceptual understanding with the ability to use the instrument in practice.

Figure 4 shows the results for dimension 4.

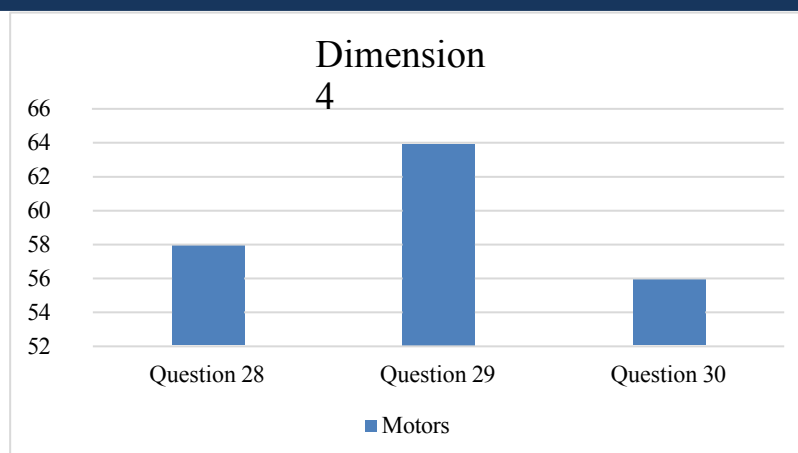


Figure 4. Results of dimension 4.

In terms of the driving force, the analysis reveals marked heterogeneity in the development of procedural skills, since, although there is clear theoretical recognition of research procedures, difficulties are observed in their systematic execution. There is a consistent familiarity with processes such as bibliographic searches, abstract structure, and basic use of data collection instruments, among others. However, there are significant weaknesses in their application with regard to statistical procedures, the preparation of academic papers, and the systematic management of the stages of interpretation and discussion of results, which implies that the automation of these practical skills still requires further practice and methodological support.

Figure 5 shows the results for dimension 5.

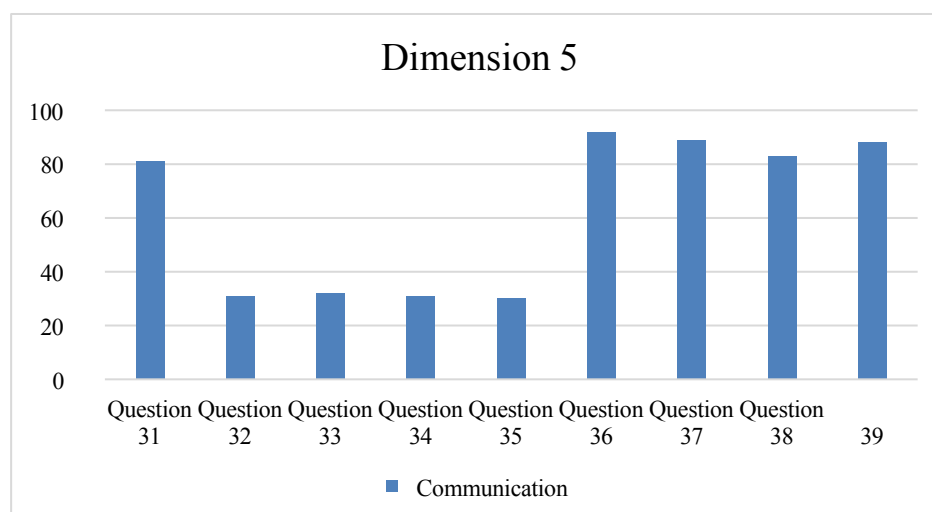


Figure 5. Results for dimension 5.

Finally, the communication dimension revealed the greatest areas of opportunity, with significant limitations in the ability to disseminate and socialize the scientific knowledge produced. Although some subjects showed familiarity with the most basic aspects of academic presentations and writing, we found significant gaps in more specialized skills, such as publishing in indexed journals, selecting appropriate media for dissemination based on scientific classification criteria and variety of topics covered, and writing abstracts in languages used for international communication. The discrepancy observed is indicative of the disconnect between the ability to generate knowledge and the possibility of translating it into academic products that can be successfully socialized within the scientific community.

CONCLUSIONS

The assessment of research skills among first-semester students at a Mexican public university reveals a mixed picture, showing both significant achievements and considerable challenges in early research training. The findings obtained using the adapted instrument developed by Balbo et al. (2015) allow us to draw the following main conclusions:

Students have a solid conceptual foundation in the theoretical fundamentals of research. This includes an adequate understanding of the fundamental concepts of science, technology, and research. At the same time, students have positive attitudes toward research, which implies an open mind, a critical predisposition, and an appreciation of knowledge. Once again, this establishes a solid foundation for competence.

Areas for improvement were identified in the cognitive, motor, and, above all, communicational dimensions. Students do indeed have difficulties in formulating a precise research problem, in developing a consistent review of the literature, in rigorously applying statistical procedures, and, even more strongly, in disseminating and socializing scientific knowledge through publications and presentations in specialized media.

The results reveal a student profile that is characterized by a basic theoretical understanding but difficulties in practical application and academic communication. In other words, the findings indicate that the training process was effective in conveying basic concepts, but it is clear that it needs to be strengthened in terms of procedural and communication skills.

Discussion

The results obtained partially coincide with the findings of Corona et al. (2024), who identified methodological mastery as the area of greatest development in Mexican university students. However, our study reveals that this evolution is not uniform among first-semester students, suggesting that the development of research skills requires a more extensive maturation process.

The gap between understood theory and its actual application presents evidence of what Cardoso and Cerecedo (2019) call the structural lack of key elements of the investigative method. It is observed that the specific difficulty does not lie so much in the transition from abstract knowledge, but rather in the effective connection between conceptual foundations and their materialization in research practice.

The weakness detected in the communicative dimension is worrying, given the assertion by Ríos Cabrera et al. (2023) about the efficiency of social constructivism in promoting research skills. That is why combining digital technologies and collaborative methods seems promising for improving academic communication skills.

The variability in competence observed is similar to that expressed by Girón Márquez (2021) regarding the fundamental role of the microcurriculum teacher. Individual differences in competence could stem from variability in teaching strategies within academic programs. The above conclusions also imply that the classic research training model based on the transfer of theoretical knowledge cannot help students develop the appropriate practical and communication skills in a modern academic context. In this sense, the situation leads to the need to reshape the course approach around experience-based learning and the regular practice of complex research skills.

FUTURE WORK

The need refers to the development and validation of integrated pedagogical interventions to strengthen the need to successfully articulate theoretical knowledge with research practice. The results indicated that, despite having strong conceptual foundations, students faced considerable difficulties in the practical application and communication of research results. It is also suggested that multifactorial analysis of a range of institutional, sociocultural, and technological variables that affect the differential development of research skills points to the influence of multiple contextual factors that were not systematized. Most of the proposals formulated

are linked to the search for and identification of all variables that may determine individual and institutional differences in the development of research competence.

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Validation	García Parada Ricardo, Marrón Ramos Domingo Noe
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