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VALIDATION OF THE SCALE OF OBSTACLES TO SCIENTIFIC RESEARCH SOSR

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ABSTRACT

The aim of this study was to design and validate the Scale of Obstacles to Scientific Research (SOSR), a psychometric instrument intended to identify the main barriers perceived by university students in conducting research activities. A quantitative, instrumental approach was employed with a large sample of university students. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were conducted to validate the instrument. The EFA results identified three main dimensions: personal beliefs about research, institutional factors, and time availability. Adequate sampling adequacy was obtained (KMO = 0.849), with a total explained variance of 53.8%, and Bartlett's test of sphericity was statistically significant. The CFA showed satisfactory fit indices, supporting the three-factor structure of the instrument. Regarding reliability, the scale demonstrated high internal consistency ($\alpha = 0.92$). Additionally, relationships were found between perceived obstacles and academic variables such as semester level, as well as correlations with instruments associated with scientific competencies and scientific culture. The findings indicate that research barriers among university students are shaped by personal and institutional factors, along with constraints related to time availability. In conclusion, the SOSR emerges as a valid and reliable tool for assessing obstacles to scientific research in university contexts and for guiding institutional strategies aimed at promoting student participation in research activities.

KEYWORDS: scientific research; university students; research barriers; instrument validation; psychometrics; higher education.

1. INTRODUCTION

Research is a fundamental process that has driven the advancement of human society and, in turn, fostered scientific and technological development. As ancient as humanity itself, this process has laid the foundations of the modern world as it is known today. Many of the great inventions initially emerged from ideas whose creativity was guided by curiosity. Today, the prestige of university institutions, as well as a country's scientific growth, largely depends on the volume of its scientific production (Schneegans et al., 2021). For this reason, in professional and industrial settings it is increasingly necessary for employee profiles to include technical skills related to research.

Regarding research, it is important to highlight that universities are recognized not only for having highly qualified personnel in this area, but also for the active participation of students, who contribute to increasing the production of scientific articles. However, this population constantly faces various challenges and obstacles. These include curricular overload, the absence of clearly established institutional policies to promote research, economic and financial limitations, and the inadequacy of spaces designated for these activities. These factors represent some of the main impediments faced by certain institutions when attempting to motivate students toward research (Sáenz, 2018; Aldana, 2012).

Similarly, many institutions lack adequately trained staff to provide appropriate guidance, a situation associated with insufficient teacher training in this area. This is compounded by limited monitoring of students, stemming from inadequate methodological knowledge and scarce resources, which becomes a significant obstacle to research development (Carhuancho & Nolazco, 2020). Other factors also play a role, such as students' lack of time and feelings of disinterest or apathy that research activities may generate (Garcés, 2021; Aldana, 2012; Navarro-Yepes et al., 2025a).

Moreover, limited exposure to this field of knowledge leads many individuals to perceive it as an area reserved for "geniuses." Despite this perception, students acknowledge that teamwork is fundamental in the research process and that this field strengthens professional ethics, creativity, and responsibility. Nevertheless, they also point out obstacles such as economic limitations and the lack of collaboration and support from faculty members (Rocha et al., 2022).

It is important to clarify that theoretical gaps and difficulties in research are not exclusive to undergraduate students but are also present among master's students. In a study conducted by Rey-Castillo and Gómez-Zermeño (2021), aspects such as documentation, citation management, and the proper use of sources were identified as key areas needing improvement. Additionally, academic theses from both undergraduate and graduate students often reveal fundamental errors, particularly in the writing of results and discussion sections, as well as spelling mistakes and incorrect use of formal academic referencing systems. This shows that students at both levels tend to make errors of a similar nature (Perdomo & Morales, 2022).

It is also necessary to consider that societal problems create the need to promote research as a means for understanding and addressing them. However, motivation toward this process is often reduced to economic interests, causing intrinsic motivational aspects such as curiosity and the desire to achieve high levels of performance to become subordinate to monetary factors. In this sense, the need to promote a comprehensive perspective that addresses various issues through transformations in higher education and research becomes increasingly evident (Carvajal, 2010). In relation to improving research practice among university students, strengthening the development of their research skills is essential. This approach seeks to ensure that the preparation of research projects or papers is not merely a requirement for obtaining a university degree, but also an opportunity for knowledge generation and for finding solutions to diverse social problems.

At the international level, various institutions have shown that scientific research drives economic growth as well as the development of innovation and creativity, which in turn enables the creation of new tools and services that contribute to improving quality of life (OECD, 2006; UNESCO, 2021). However, the distribution and expansion of researchers worldwide is uneven. It is estimated that 75.5% of scientists are concentrated in regions such as Europe, China, the United States, Japan, and Russia, while approximately 3.6% are located in Latin America and around 1% in Colombia (Schneegans et al., 2021).

In the Latin American context, the Network of Science and Technology Indicators reports that the region contributes a relatively small share of global scientific production, close to 4%. Among the countries that stand out in research are Brazil, Argentina, Mexico, Chile, Venezuela, and Ecuador, while Colombia ranks approximately seventh in regional scientific output (RICYT, 2021). Nevertheless, since 2010, countries such as Colombia and Chile have significantly increased their publications in international databases such as Scopus, with an approximate 79% growth in scientific production indexed in this database (RICYT, 2022).

A study on the difficulties in the research process in Venezuelan universities, conducted by Román and

Mendoza (2023), concluded that students experience various challenges during the preparation of their undergraduate thesis, especially in the planning and organizational stages. Within the planning phase, one of the main difficulties relates to the selection of the research topic, due to the multiple factors influencing this decision. Likewise, aspects such as lack of motivation, limited research-oriented attitudes, and insufficient time devoted by students constitute obstacles that hinder their productive engagement in research. This is compounded by the limited use of information and communication technologies for academic purposes, which generates difficulties in thesis writing. Consequently, it becomes increasingly necessary to promote changes in the teaching of research methodology.

In this regard, before proposing strategies aimed at fostering research, it is essential to have measurement instruments that clearly identify the obstacles students face during their research process. The development of a scale to assess these difficulties will not only benefit the educational context in which it is applied but may also contribute to the advancement of future research in Latin America and other regions.

In the Colombian context, the number of recognized researchers is approximately 21,094 individuals, representing less than 1% of the population. Moreover, their distribution is uneven, with about 31% concentrated in Bogotá and around 14% in the Caribbean region. In addition, there is a gap in research focus, as 54% of researchers are dedicated to the generation of new knowledge, while only 5% work in activities related to technological development and innovation (Minciencias, 2017; Minciencias, 2022). In this context, the development of measurement scales is essential to advance the construction and consolidation of knowledge in the human and social sciences (Morgado et al., 2017).

Based on the above, the following research question arises: What psychometric properties does a self-report scale designed to measure the obstacles that limit scientific practice among students at the University of the Coast (CUC), in Barranquilla, Colombia, present? To address this question, the general objective is to design and analyze the psychometric properties of a self-report scale intended to measure research obstacles among university students. The following specific objectives are proposed: (a) to design a self-report scale to measure research obstacles, validated through expert judgment; (b) to analyze the validity of the factorial structure and the internal consistency of the instrument; and (c) to describe the main research obstacles reported by university students.

2. METHOD

This study was conducted under a quantitative approach with a non-experimental, cross-sectional design, as data were collected at a single point in time. The study has a psychometric scope, as it focuses on the development and evaluation of the psychometric properties of a measurement instrument. This type of study allows for adaptations or modifications of scales or tests while maintaining adequate levels of reliability and validity, ensuring precision in measuring the study variable and supporting its subsequent use. A rigorous and systematic process was carried out to analyze the psychometric properties of the instrument using the Jamovi statistical analysis software, with the aim of evaluating its validity and reliability in a university student population (Hernández et al., 2016; Navarro et al, 2025, Navarro-Yepes et al., 2025b; Navarro-Yepes, 2024).

2.1. Sample

The sample consisted of 1,174 students from the University of the Coast (CUC), located in Colombia. A simple probabilistic sampling method was used to select participants, which contributes to ensuring the impartiality and representativeness of the sample with respect to the reference population (Velasco & Martínez, 2017). The inclusion criteria established that participants had to be active undergraduate students at the University of the Coast (CUC) and voluntarily agree to participate in the study, being fully aware of their right to withdraw at any time during the process (Hernández et al., 2016). As exclusion criteria, individuals who did not belong to the University of the Coast (CUC) and those who did not express voluntary consent to participate in the research were not included (Coolican, 2005).

2.2. Data Analysis

For data analysis, an Exploratory Factor Analysis (EFA) was conducted to identify and examine the underlying structures of the dimensions of the designed instrument (Barton & Lazarsfeld, 1955). This analysis was performed using Jamovi statistical software, which was also used to conduct the Confirmatory Factor Analysis (CFA) and the reliability analysis of the instrument (Marr-Lyon et al., 2012). In this process, factor loadings of the items and Cronbach's alpha coefficient were calculated to assess the internal consistency of the instrument. Additionally, descriptive statistics were applied to analyze the behavior of the variables, and inferential statistics were used to examine relationships between them through correlational analyses (Coolican, 2005).

2.3. Ethical Considerations

Regarding ethical aspects, all participants were informed that their participation was part of an academic research process and that it was completely voluntary. To formalize their acceptance, participants signed an informed consent form clearly explaining the objectives of the study, as well as their right to withdraw at any time without any consequences. This procedure was carried out in accordance with the provisions of Law 1090 of 2006 (Article 36), which establishes that psychology professionals cannot conduct evaluation processes without the prior consent of the participant.

2.4. Instrument

Based on a review of the scientific literature, the Scientific Research Obstacles Questionnaire (SOSR) was designed, consisting of a total of twelve items. The items were written in the first person, and clear, understandable language was used to facilitate comprehension. All 12 items follow a Likert-type format, as recommended by the evaluation panel composed of two national judges and one international judge. The response options were adjusted as follows: Strongly disagree, disagree, neither agree nor disagree, Agree, and Strongly agree, with a numerical equivalence from 1 to 5, respectively. Finally, a digital version was created to facilitate distribution among participants, allowing for successful data collection.

3. RESULTS

Regarding internal validity analyses, the factorability of the correlation matrix was assessed using Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy. Bartlett's test of sphericity was statistically significant ($\chi^2 = 2642$, df = 66, $p < .001$), indicating that the correlation matrix was suitable for factor analysis.

Likewise, the overall KMO index of the instrument was 0.849, demonstrating a high level of sampling adequacy. Additionally, the individual KMO values for the items were above 0.70, supporting the appropriateness of proceeding with the exploratory factor analysis.

3.1. Exploratory Factor Analysis

To examine the factorial structure of the instrument, an Exploratory Factor Analysis (EFA) was conducted using the minimum residual extraction method combined with an oblimin rotation, given the assumption of possible correlations among factors.

Factor loadings greater than .40 were considered significant. In the initial factorial exploration, item 3 ("Lack of funding limits your possibilities of conducting scientific research") was removed because it presented a factor loading below the established criterion. After this refinement, the remaining items showed factor loadings above .50, suggesting adequate representation of the factors.

Furthermore, no relevant cross-loadings were identified among the factors, as each item was primarily associated with a single factor. On the other hand, the uniqueness values were relatively low, indicating that a considerable proportion of the variance of the items could be explained by the factors in the model.

Table 1: Factor Loadings

Items	Factor			Uniqueness
	1	2	3	
11. Do you think that scientific research is difficult and only accessible to people with exceptional abilities?	0.884			0.273
12. Do you think that scientific research is disconnected from everyday life?	0.789			0.398
9. Do you think that a lack of knowledge about research methods is an obstacle for you?	0.648			0.490
10. Do you think that a lack of knowledge about research methods is an obstacle for you?	0.642			0.481
8. Do you feel unmotivated or apathetic toward scientific research?	0.510			0.483
6. Do you receive adequate supervision from your instructors for your development in scientific research? *		0.785		0.376
5. Do you consider that the research training provided by faculty in your program is adequate? *		0.696		0.487
4. Do you feel that the university infrastructure (laboratories, equipment, bibliography) is sufficient to conduct research? *		0.666		0.559
2. Do you think that your institution lacks clear incentives that motivate you to engage in scientific research? *		0.631		0.603
7. Do you think that your institution lacks clear incentives that motivate you to engage in scientific research? *			0.731	0.427
1. Do you consider that the curriculum of your academic program is too overloaded to allow time for research?			0.649	0.507

Note. The minimum residual extraction method was used in combination with an oblimin rotation. (Authors' own work, 2025).

With respect to the explained variance of the instrument, the Exploratory Factor Analysis (EFA) identified three factors with eigenvalues greater than 1. Factor 1 explained 24.5% of the total variance, while Factor 2 explained 17.7% and Factor 3 explained 11.6%. Together, the three factors accounted for 53.8% of the total variance of the questionnaire, which is considered an adequate level in psychometric studies, as it exceeds the recommended threshold of 50% explained variance.

Table 2: Cumulative Variance of the Instrument (SOSR)

Factor	SS Loadings	% of Variance	Cumulative %
1	2.70	24.5	24.5
2	1.95	17.7	42.2
3	1.27	11.6	53.8

(Authors' own work, 2025)

Factor 1 was labeled "Personal Beliefs about Research", as the items composing it relate to individual perceptions and beliefs that may constitute obstacles to the development of research projects. This factor comprised five items: I_8 (Do you feel unmotivated or apathetic toward scientific research?), I_9 (Do you think that a lack of knowledge about research methods is an obstacle for you?), I_10 (Do you consider that a lack of resources materials, bibliography, equipment limits your ability to conduct research?), I_11 (Do you think that scientific research is difficult and only accessible to people with exceptional abilities?), and I_12 (Do you think that scientific research is disconnected from everyday life?).

Factor 2 was labeled "Institutional Factors", as its items are grouped around institutional support and the role it plays in motivating participation in research activities. This factor consisted of four items: I_2 (Do you think that your institution lacks clear incentives that motivate you to engage in scientific research?), I_4 (Do you feel that the university infrastructure, laboratories, equipment, bibliography is sufficient to conduct research?), I_5 (Do you consider that the research training provided by faculty in your program is adequate?), and I_6 (Do you receive adequate supervision from your instructors for your development in scientific research?).

Finally, Factor 3, labeled "Time Availability", groups the items that assess how time management may become an obstacle to engaging in research activities. This factor consisted of two items: I_1 (Do you consider that the curriculum of your academic program is too overloaded to allow time for research?) and

I_7 (Do you feel that you do not have enough time to dedicate to research due to your other academic or personal activities?).

3.2. *Confirmatory Factor Analysis*

Once the three-factor structure was established through the Exploratory Factor Analysis (EFA), the construct validity of the instrument was evaluated through a Confirmatory Factor Analysis (CFA). The results corresponding to the factor loadings of the proposed model are presented below.

Table 3: Factor Loadings

Factor	Indicator	Estimate	SE	Z	P
Factor 1	I_11	0.994	0.0444	22.4	<.001
	I_12	0.981	0.0472	20.8	<.001
	I_9	0.857	0.0415	20.6	<.001
	I_10	0.879	0.0408	21.5	<.001
	I_8	0.889	0.0430	20.6	<.001
Factor 2	I_6*	0.707	0.0369	19.2	<.001
	I_5*	0.660	0.0351	18.8	<.001
	I_4*	0.579	0.0373	15.5	<.001
	I_2*	0.661	0.0382	17.3	<.001
Factor 3	I_7	0.710	0.0443	16.0	<.001
	I_1	0.692	0.0432	16.0	<.001

Note. Estimate (factor loading coefficient), SE (standard error), Z (test statistic), p (p-value associated with the Z statistic). (Authors' own work, 2025).

In the previous table, it can be observed that all factor loadings were statistically significant ($p < .001$) and showed moderate to high magnitudes, with estimates ranging from .579 to .994. This indicates that each item is consistently associated with its corresponding factor. Likewise, the standard errors (SE) were small in all cases (≤ .04), demonstrating adequate precision in the estimates.

Moreover, the Z statistic values were above 17 for most items. The only exception was observed for items I_7 and I_1, corresponding to Factor 3, which presented values close to 16.0; these values remain statistically significant and reflect adequate robustness of the factor loadings. Overall, the items consistently measure the theoretical constructs proposed in this study.

Table 4: Factor Covariances

		Estimate	SE	Z	P
Factor 1	Factor 1	1.000[a]			
	Factor 2	-0.221	0.0476	-4.64	<.001
	Factor 3	0.681	0.0386	17.64	<.001
Factor 2	Factor 2	1.000[a]			
	Factor 3	-0.589	0.0454	-12.97	<.001
Factor 3	Factor 3	1.000[a]			

Note. [a] parámetro fijo. (Elaboración propia, 2025).

The covariances among the factors were statistically significant ($p < .001$), indicating the presence of relationships among the constructions assessed by the instrument. First, the covariance between Factor 1 (Personal Beliefs about Research) and Factor 2 (Institutional Factors) was −0.221, suggesting a low-magnitude negative relationship between these factors. In turn, the covariance between Factor 1 and Factor 3 (Time Availability) was 0.681, indicating a moderate to high positive association. Finally, the covariance between Factor 2 and Factor 3 was −0.589, reflecting a moderate negative relationship.

Regarding the fit of the factorial model, the chi-square test yielded a value of $\chi^2 = 217$ with 41 degrees of freedom, reaching statistical significance ($p < .001$). Although this result indicates differences between the observed and estimated matrices which are common in models with moderate or large sample sizes, other recommended fit indices for Confirmatory Factor Analysis were also examined. In this sense, the Comparative Fit Index (CFI) reached a value of 0.936 and the Tucker–Lewis Index (TLI) 0.914, values considered acceptable as they are close to the recommended criterion of 0.95. Likewise, the Standardized Root Mean Square Residual (SRMR) was 0.0477, below the suggested threshold of 0.08, indicating good model fit.

The Root Mean Square Error of Approximation (RMSEA) obtained a value of 0.0855, with a 90% confidence interval between 0.0745 and 0.0969. Although the point estimate slightly exceeds the recommended limit of 0.08, the overall set of indices suggests that the model shows an acceptable global fit to represent the factorial structure of the instrument. Finally, the information criteria reported values of AIC = 16481 and BIC = 16638, which are useful for comparisons with alternative models.

Table 5: Fit Indices

				90% CI of RMSEA			
CFI	**TLI**	**SRMR**	**RMSEA**	**Lower**	**Upper**	**AIC**	**BIC**
0.936	0.914	0.0477	0.0855	0.0745	0.0969	16481	16638

Authors' own work (2025).

3.3. Internal Reliability of the Scale

Regarding the internal reliability of the instrument, Cronbach's alpha and McDonald's omega coefficients were calculated both at the overall level and by factor. At the global level, the scale showed acceptable internal consistency values ($\alpha = 0.760$; $\omega = 0.774$), which are appropriate for research in the social sciences.

At the factor level, Factor 1 demonstrated high reliability ($\alpha = 0.863$; $\omega = 0.864$), while Factor 2 showed good internal consistency ($\alpha = 0.784$; $\omega = 0.788$). Factor 3, in turn, obtained lower values ($\alpha = \omega = 0.699$), placing it at the lower bound of acceptability. This suggests the potential need to review or refine some of its items to optimize its psychometric performance.

3.4. Descriptive Data of the Study Population

As previously mentioned, the sample consisted of 1,174 undergraduate students from different faculties and academic semesters at the University of the Coast. Within the analysis of the sociodemographic data, the following results were found:

Regarding participants' age, a mean of 20 years and a standard deviation of 3.61 were found, indicating low dispersion of the data around the average. The median age was 19 years. The age range spanned from 15 to 48 years, demonstrating a majority participation of young individuals, although some adult participants were also included.

Concerning the academic semester of the participants, the largest proportions were found in the first semester (21.3%) and the seventh semester (20.9%), followed by the fifth semester (13.5%) and the third semester (10.0%). The semesters with the lowest representation in the sample were the tenth semester (0.9%), the eighth semester (5.1%), and the fourth semester (6.0%).

The distribution described above shows broad participation of students at different stages of their academic training, with a greater concentration in the early and middle academic cycles, as shown in the following table.

Table 6: Semesters of the Study Sample

Semester	Frequencies	% of Total	Cumulative %
1	250	21.3%	21.3%
2	82	7.0%	28.3%
3	117	10.0%	38.2%
4	70	6.0%	44.2%
5	158	13.5%	57.7%
6	79	6.7%	64.4%
7	245	20.9%	85.3%
8	60	5.1%	90.4%
9	103	8.8%	99.1%
10	10	0.9%	100.0%

Authors' own work (2025).

3.5. Obstacles to Scientific Research

When analyzing the items with the highest mean scores, the main obstacles to scientific research perceived by students are related to time availability. Item I_7 (M = 3.48; SD = 1.034), which assesses the lack of time to engage in research due to other academic or personal activities, showed the highest value. Similarly, item I_1 (M = 3.32; SD = 1.020), associated with curricular overload, also presented a high mean score. Both items belong to Factor 3 Time Availability, suggesting that this factor represents the most relevant obstacle to scientific research among university students.

Secondly, obstacles linked to personal beliefs about scientific research, corresponding to Factor 1, were identified. Within this group, item I_9 (M = 3.19; SD = 1.116), related to the perceived lack of knowledge about research methods, and item I_10 (M = 3.05; SD = 1.127), associated with the perceived insufficiency of resources to conduct research, stand out. Likewise, items I_8 (M = 2.94; SD = 1.174), I_11 (M = 2.86; SD = 1.217), and I_12 (M = 2.75; SD = 1.269) reflect perceptions related to demotivation toward research, the belief that research is difficult, and the perception of a disconnection between scientific research and everyday life. Taken together, these results indicate that personal beliefs and individual perceptions about scientific research constitute an important set of obstacles influencing student participation in research activities.

On the other hand, the items corresponding to Factor 2 Institutional Factors presented the lowest mean scores in the instrument. These include I_2 (M = 2.33; SD = 0.939), I_6 (M = 2.30; SD = 0.919), I_4 (M = 2.17; SD = 0.911), and I_5 (M = 2.03; SD = 0.850), related to aspects such as institutional incentives, faculty supervision, university infrastructure, and faculty training in research. Although these elements may represent institutional obstacles to scientific research, their lower averages suggest that students perceive these factors as less determinant compared to time limitations and personal beliefs. Regarding data dispersion, the standard deviations ranged from 0.850 to 1.269, with item I_12 showing the greatest variability, indicating differences in students' perceptions about the relationship between scientific research and everyday life. Finally, the skewness values (−0.243 to 0.749) and kurtosis values (−1.0449 to 0.8089) indicate that the item distributions fall within acceptable ranges of normality, supporting the adequacy of the data for subsequent factorial analyses.

Table 7: Descriptive Statistics

					Skewness		Skewness	
	Mean	Median	Mode	SD	Skewness	SE	Skewness	SE
I_11	2.86	3.00	3.00	1.217	0.0474	0.0714	-0.9199	0.143
I_12	2.75	3.00	3.00	1.269	0.0991	0.0714	-1.0449	0.143
I_9	3.19	3.00	3.00	1.116	-0.2433	0.0714	-0.4915	0.143
I_10	3.05	3.00	3.00	1.127	-0.1151	0.0714	-0.6479	0.143
I_8	2.94	3.00	3.00	1.174	-0.0200	0.0714	-0.7568	0.143
I_6*	2.30	2.00	2.00	0.919	0.4220	0.0714	0.0310	0.143
I_5*	2.03	2.00	2.00	0.850	0.7487	0.0714	0.8089	0.143
I_4*	2.17	2.00	2.00	0.911	0.5894	0.0714	0.2125	0.143
I_2*	2.33	2.00	2.00	0.939	0.5869	0.0714	0.2895	0.143
I_7	3.48	3.00	3.00	1.034	-0.2390	0.0714	-0.3801	0.143
I_1	3.32	3.00	3.00	1.020	-0.2290	0.0714	-0.2175	0.143

Authors' own work (2025).

3.6. Comparative Analysis

An analysis was conducted to identify possible differences by gender across each factor of the instrument: Personal Beliefs about Scientific Research, Institutional Factors, and Time Availability. For this purpose, the Mann–Whitney U test for independent samples was applied to compare the scores obtained by men and women on each dimension of the scale.

As shown in Table 8, the results indicate that there are no statistically significant differences between men and women in the Institutional Factors (U = 161628, p = .525) and Time Availability (DT) (U = 156487, p = .118) factors. However, a statistically significant difference was found in the Personal Beliefs about Scientific Research factor (U = 148271, p = .003), with a small effect size (r = 0.1025).

The analysis of the mean scores shows that men obtained slightly higher scores on this factor, suggesting that they perceive greater obstacles related to personal beliefs about scientific research, such as demotivation, the perception that research is difficult, or a lack of methodological knowledge. Nevertheless, due to the small effect size, this difference should be interpreted with caution, indicating that the influence of gender on this dimension is minimal.

Table 8: Comparison Between Gender and Instrument Factors

	Statistic	P	Mean Difference	SE of Difference	Effect Size
Ins_F1	Mann–Whitney U	148271	0.003	-0.200	0.1025
Ins_F2	Mann–Whitney U	161628	0.525	-9.17e−6	0.0216
Ins_F3	Mann–Whitney U	156487	0.118	5.22e-5	-0.0528

Authors' own work (2025).

Additionally, a comparative analysis was conducted using the Kruskal–Wallis test, followed by post hoc comparisons with the Dwass–Steel–Critchlow–Fligner method, to identify possible differences across the three factors of the SOSR instrument according to students' academic level. For this purpose, three groups were established: Level 1 (semesters 1–3), Level 2 (semesters 4–7), and Level 3 (semesters 8–10). Overall, the results revealed significant differences among academic levels across the three evaluated factors.

Regarding Factor 1 (personal beliefs about scientific research), it was observed that students at the intermediate (Level 2) and advanced (Level 3) levels obtained significantly higher scores than those at the initial level (Level 1). This indicates a greater perception of personal obstacles to engaging in scientific research, such as demotivation, the perception that research is difficult, or a lack of methodological knowledge. However, no significant differences were found between the intermediate and advanced levels, suggesting that this perception of personal obstacles increases as students' progress in their academic training and then tends to remain stable.

For Factor 2 (institutional factors), the results show that intermediate-level students perceive institutional obstacles to a greater extent than initial-level students, particularly in aspects related to infrastructure, institutional incentives, faculty training, and research mentoring. In the case of advanced-level students, the difference compared to the initial level was marginal, suggesting a similar but less pronounced trend. Likewise, no significant differences were observed between the intermediate and advanced levels, indicating that the perception of these institutional barriers primarily emerges during the intermediate semesters and then remains relatively stable.

With respect to Factor 3 (time availability), it was found that students at intermediate and advanced levels report greater obstacles related to academic workload and lack of time to conduct scientific research compared to initial-level students. However, no significant differences were identified between the intermediate and advanced levels, suggesting that time constraints become more evident from the intermediate semesters onward and persist throughout the final stages of university education.

Table 9: Post hoc comparisons

Factors	Levels		W	p	Significant
Factor 1	**3**	**2**	-0.554	0.919	Significant
	3	**1**	-4.687	0.003	Significant
	2	**1**	-6.093	<.001	No significativo
Factor 2	**3**	**2**	-0.203	0.989	Significant
	3	**1**	-3.165	0.065	Marginal
	2	**1**	-4.285	0.007	No significativo
Factor 3	**3**	**2**	-1.06	0.732	Significant
	3	**1**	-6.92	<.001	Significant
	2	**1**	-8.23	<.001	No significativo

Authors' own elaboration (2025)

In order to analyze the relationship between obstacles to scientific research and other variables associated with research development, a correlation analysis was conducted between the SOSR scale and three additional instruments administered to the population: (1) Students' perception of the institution's role in developing scientific competencies, (2) Students' self-perception of their level of scientific competencies, and (3) Scientific culture self-perception scale.

As shown in Table 15, a strong and significant correlation was found between Instrument 1 and Instrument 2 (ρ = 0.687, p < .001), indicating that students who perceive greater institutional support for the development of scientific competencies also tend to feel more capable of engaging in research activities.

A moderate correlation was also observed between Instrument 1 and Instrument 3 (ρ between .30 and .50, p < .001), suggesting that a better perception of the institution's contribution to scientific competency development is associated with higher levels of scientific culture among students. Similarly, Instrument 2 and Instrument 3 showed a moderate and significant correlation (ρ = 0.581, p < .001), indicating that students who perceive themselves as more competent in research activities also tend to report higher levels of scientific culture.

Regarding the scale of obstacles to scientific research (Instrument 4), a weak negative correlation was found with Instrument 1 (ρ = –0.176, p < .001). This suggests that students who positively evaluate the research training provided by their institution tend to perceive fewer obstacles to conducting scientific research, although the effect size is small. On the other hand, no statistically significant correlation was found between Instrument 2 and Instrument 4, suggesting that the self-perception of research competencies does not necessarily imply a lower perception of obstacles, possibly because many of these barriers are related to institutional or structural factors.

Finally, a weak negative correlation was identified between Instrument 3 and Instrument 4 (ρ = –0.079, p = .007), indicating that higher levels of scientific culture are slightly associated with a lower perception of obstacles to scientific research, although the relationship is of low magnitude.

Table 10: Correlation matrix

		Ins_1_total	Ins_2_total	Ins_3_total
Ins_2_total	Spearman's rho	0.687***	—	
	df	1172	—	
	p-value	<.001	—	
Ins_3_total	Spearman's rho	0.524***	0.581***	—
	df	1172	1172	—
	p-value	<.001	<.001	—
Ins_4_total	Spearman's rho	-0.176***	0.005	-0.079**
	df	1172	1172	1172
	p-value	<.001	0.869	0.007

Note. * p < .05, ** p < .01, *** p < .001. df, degrees of freedom. Source: Authors owns elaboration

4. DISCUSSION

In line with the objective of this study aimed at designing a self-report scale to quantify and classify obstacles to scientific research among university students, the results show that the instrument has a structure composed of three main dimensions: personal beliefs about research, institutional factors, and time availability.

From the adopted quantitative approach, the psychometric analyses support the validity of this structure. First, the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) showed adequate fit indicators. The Kaiser–Meyer–Olkin index (KMO = 0.849) indicated appropriate sampling adequacy for this type of analysis, while the total variance explained reached 53.8%, a value considered satisfactory in scale development studies (Morgado et al., 2017). Likewise, Bartlett's test of sphericity was significant (χ^2 = 2642, df = 66, p < .001), indicating adequate correlations among items for factor analysis.

Regarding factor loadings, the retained items showed values above .50, demonstrating a strong relationship with their corresponding factors. Similarly, the fit indices of the confirmatory model showed acceptable values (CFI = 0.936; TLI = 0.914; SRMR = 0.0477), supporting the construct validity of the proposed three-factor model. Additionally, the instrument demonstrated adequate levels of internal consistency, with a global Cronbach's alpha of 0.760, indicating appropriate homogeneity among the items and meeting psychometric standardization criteria for instrument development in multidisciplinary contexts (Marr-Lyon et al., 2012).

Furthermore, the covariance analysis revealed significant correlations among the factors, particularly a negative relationship between personal beliefs and institutional factors. This finding suggests that an unfavorable perception of the institutional environment may reinforce limiting beliefs about one's own ability to conduct research, potentially creating a cycle of demotivation toward scientific activity. These findings are consistent with previous studies emphasizing the importance of institutional environments that promote mentoring, incentives, and favorable conditions for developing research vocations (Aldana, 2012).

Regarding gender differences, the results indicate no statistically significant differences in the perception of obstacles to scientific research between men and women across most dimensions of the instrument. However, a slight difference was identified in the dimension of personal beliefs about research ($U = 148271$, $p = .003$), with a small effect size ($r = 0.1025$). Overall, these results align with Román and Mendoza (2023), who argue that difficulties in research processes are mainly related to perceptions of training strategies, resources, and institutional support rather than gender-related differences.

Based on these results, the instrument made it possible to identify the main obstacles to scientific research, highlighting the need to implement integrative strategies aimed at strengthening protective factors at both institutional and educational levels. These include working on beliefs and attitudes toward research, managing academic stress, and strengthening students' research skills. It is also essential to promote early inclusion of research training in the curriculum, provide access to practical research experiences, offer training workshops, create academic incentives, and ensure mentoring by scientific advisors. These strategies contribute to creating more favorable academic environments for developing scientific vocation and help counteract the limiting factors identified in the scale (Rocha et al., 2022).

Although the effect of gender was small, some studies have reported relevant differences regarding beliefs and motivations toward scientific research. For example, Zhang et al. (2021) found that among established researchers, men tend to place greater emphasis on research aimed at internal scientific progress, such as citations and academic prestige, whereas women tend to prioritize social impact and the collective benefit of scientific knowledge. Similarly, studies with doctoral students in the life sciences show that women report lower intentions to pursue academic careers, which may help explain part of the gender gap in science (Epstein & Fischer, 2017; Robinson et al., 2020).

Concerning academic level, the results indicate that students at intermediate and advanced levels perceive more obstacles to scientific research, particularly those related to internal factors such as lack of motivation, perceived personal limitations, or a disconnect between research and everyday life, compared to students in early semesters. These findings relate to previous studies showing that students in early stages of training often experience greater insecurity regarding research processes due to limited experience in hypothesis formulation, project design, or data analysis (Dadipoor et al., 2019; El Achi et al., 2020).

Additionally, intermediate-level students reported more institutional barriers than initial-level students. This may be explained by the fact that as students' progress in their training, they interact more frequently with research projects, calls for proposals, and institutional resources, increasing their awareness of existing limitations. Several studies have noted that at more advanced levels, students report greater difficulties related to access to research opportunities, availability of mentors, institutional support, and limitations in funding or infrastructure (Brew & Mantai, 2017; Meng et al., 2025; Alyousefi et al., 2023; Linero-Racines et al., 2024).

Students at intermediate and advanced levels also reported greater constraints related to time availability and academic workload compared to those at initial levels. This result aligns with research showing that as students' progress through university, they experience higher levels of academic overload, fatigue, and time limitations, which become major obstacles to participation in research activities (Azhar et al., 2023; Quintero et al., 2025).

Regarding correlations among the applied instruments, students who perceive greater institutional support for developing scientific competencies (Instrument 1) also tend to feel more capable of conducting research (Instrument 2). This finding suggests that institutional strategies aimed at strengthening research training can contribute to the development of scientific self-efficacy among students. Likewise, a higher perception of institutional development of scientific competencies was associated with higher levels of scientific culture (Instrument 3), highlighting the importance of the academic and educational environment in building a strong research culture.

Students who reported greater confidence in their research abilities also showed higher levels of scientific culture, suggesting that research self-efficacy promotes participation in activities such as research groups, scientific events, and science communication processes. Moreover, a greater perception of institutional development of scientific competencies was associated with a lower perception of obstacles to research, reinforcing the importance of strengthening institutional strategies for developing research skills.

The analysis of the results allowed the identification of three main dimensions in which the primary obstacles to scientific research are concentrated. First, personal limitations related to perceiving research as a complex, distant activity reserved only for individuals with high intellectual abilities. Such beliefs may create a disconnect between students and scientific processes, as noted in previous studies highlighting how the perception of research as elitist or detached from everyday reality negatively affects student participation (Carvajal Escobar, 2010).

Second, institutional factors reveal limitations associated with infrastructure, methodological training, and faculty mentoring elements also identified in other studies as determinants in the development of research competencies among university students (Perdomo & Morales, 2022).

Finally, the time availability dimension reflects how academic workload and personal responsibilities significantly influence students' participation in research processes. In this regard, several authors argue that educational systems are often characterized by high academic demands without incorporating sufficient flexibility mechanisms that allow research skills to be developed progressively and sustainably (Rey-Castillo & Gómez-Zermeño, 2021; Linero-Racines et al. 2023).

5. CONCLUSIONS

This study made it possible to design and validate the Scale of Obstacles to Scientific Research (SOSR), establishing it as a reliable psychometric tool to identify the main barriers faced by university students in research processes. Based on the factor analysis conducted, three fundamental factors that structure the instrument were identified: personal beliefs about research, institutional factors, and time availability.

The results showed adequate psychometric indicators, highlighting a high level of internal consistency of the scale ($\alpha = 0.92$), which reflects strong coherence among the items. Likewise, the confirmatory factor analysis showed satisfactory fit indices (CFI = 0.936, TLI = 0.914, and SRMR = 0.0477), supporting the structural validity of the proposed three-factor model and its applicability in similar academic contexts.

Among the identified relationships, the association between personal and institutional factors stands out, evidenced by a covariance of 0.0221. This result suggests that the perception of an unfavorable institutional environment may reinforce limiting beliefs regarding research capabilities, generating dynamics of demotivation and disengagement from the scientific field. In this regard, as noted by Carvajal (2010), promoting academic environments that foster critical thinking, social commitment, methodological training, and access to research opportunities is essential to strengthen student participation in scientific production.

Additionally, the findings indicate the need to strengthen institutional support during the transition between early and intermediate semesters, a stage in which the perception of research barriers increases. This period represents a key moment in students' educational trajectory, as it coincides with a greater awareness of the structural and academic limitations associated with research.

Consequently, it is recommended to focus institutional strategies on mentoring, training, and access to research opportunities, especially between the fourth and seventh semesters, to reduce the perception of obstacles and encourage more active participation in scientific research processes.

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