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The association between mathematics-related academic programs and research performance in Peruvian universities (2019–2024)

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***Abstract* –This study examines research output in mathematics across licensed Peruvian universities using a bibliometric approach based on Scopus and SciVal data for the period 2019–2024. The objective was to analyze institutional differences in research productivity and citation impact, with particular emphasis on the presence of formal mathematics-related academic programs. Four bibliometric indicators were considered: scholarly output, total citations, citations per publication, and field-weighted citation impact. The analysis included 80 universities with measurable production in the mathematics subject area, and non-parametric statistical methods were applied due to the highly skewed distribution of the indicators. The results show a strong concentration of scholarly output in a limited number of institutions. Statistically significant differences in productivity were identified between universities with and without academic programs in mathematics and statistics, indicating that the existence of specialized programs is associated with higher research output. In contrast, no significant differences were observed for citation-based indicators, suggesting that increased productivity does not necessarily translate into greater citation impact. These findings suggest an association between the presence of mathematics- and statistics-related academic programs and research productivity in mathematics, highlighting the need for contextualized interpretation of bibliometric indicators.**

***Keywords*-- Bibliometrics; Mathematics research productivity; Universities.**

I. Introduction

Research activity in Mathematics plays a strategic role in higher education systems, as it reflects both the theoretical strength of institutions and their capacity to contribute to scientific knowledge across multiple disciplines. In recent years, research productivity and scientific impact have become key indicators for evaluating university performance worldwide, particularly through bibliometric approaches that quantify scholarly output and citation-based influence. Recent studies highlight that bibliometric indicators provide a robust framework for assessing institutional research performance, allowing comparisons across universities and disciplines while accounting for differences in publication practices and citation behavior [1], [2]. Within this context, the field of mathematics constitutes a strategic area for evaluating research capacity, given its transversal relevance across science, engineering, and education.

In Peru, the implementation of the University Law (Law No. 30220) marked a turning point for the national higher education system, leading to a sustained increase in scientific production indexed in international databases. Bibliometric evidence shows that Peruvian universities have experienced significant growth in publications during the last decade; however, this growth has been unevenly distributed across institutions [1]. Recent analyses based on Scopus data reveal substantial heterogeneity in research productivity, with a small number of universities concentrating a large proportion of scientific output, while many others exhibit limited or marginal participation in indexed research [3]. This unequal distribution is particularly evident in foundational disciplines such as mathematics, where institutional capacities and research trajectories differ markedly across universities.

Previous studies have explored factors associated with university research performance, including research policies, institutional engagement, and collaborative practices. Evidence suggests that organizational and structural characteristics of universities are associated with differences in scientific production, although these relationships are often examined at an aggregate level rather than within specific disciplinary fields [4], [5]. At the same time, recent bibliometric reviews in mathematics and mathematics education document a growing volume of research and evolving thematic trends, but they rarely address how internal academic structures—such as the presence of dedicated academic programs—may shape institutional research output and impact [6]. Consequently, there remains limited empirical evidence on whether specialized academic units in mathematics and related fields contribute to stronger research performance at the university level.

Against this background, the present study aims to analyze whether the presence of academic programs in mathematics, statistics, and mathematics education in Peruvian universities is associated with higher levels of scientific production and impact in the field of mathematics. Using a bibliometric approach based on SciVal and Scopus data, this study examines scholarly output, citations, citations per publication, and field-weighted citation impact (FWCI) for the period 2019–2024, comparing universities with and without such academic units. By focusing on institutional structure within a specific disciplinary domain, this research seeks to contribute empirical evidence to the discussion on how organizational arrangements within universities relate to research productivity and scientific visibility in mathematics.

II. Methodology

A. Study design and bibliometric indicators

This study adopted a quantitative, descriptive, and comparative bibliometric design to assess the research performance of Peruvian universities in the field of mathematics. Four bibliometric indicators were used to

capture different dimensions of institutional research performance. Scholarly output was employed as a measure of productivity, reflecting the total number of publications indexed during the study period. Citations were used to represent the overall academic influence of this production, while citations per publication provided an average measure of citation impact per document. Additionally, the FWCI was included to evaluate relative citation performance by normalizing for differences in discipline, publication type, and publication year, using a global benchmark value of 1.0.

B. Selection and classification of universities

The study population consisted of Peruvian universities licensed by the Superintendencia Nacional de Educación Superior Universitaria (SUNEDU), the official governmental body responsible for regulating higher education institutions. From the total of 98 licensed universities, those with measurable scholarly output in the field of mathematics indexed in SciVal were selected, resulting in a final sample of 80 universities.

Universities were classified according to the presence or absence of three types of specialized academic programs: Mathematics, statistics, and mathematics education. This classification was justified by the broad scope of the mathematics subject area in Scopus, which includes a wide range of subdisciplines such as applied mathematics, statistics and probability, computational mathematics, modeling and simulation, algebra, analysis, geometry, discrete mathematics, mathematical physics, control and optimization, and related areas. Given this disciplinary breadth, research activity in mathematics may be distributed across different but closely related academic units.

C. Data sources and search strategy

Bibliometric data were retrieved using SciVal, an analytical platform developed by Elsevier that is based on data indexed in the Scopus database [6]. SciVal was selected due to its broad coverage and its ability to generate standardized bibliometric indicators at the institutional level. The All Science Journal Classification (ASJC) scheme was used to identify and organize publications within the Mathematics subject area. Data extraction was conducted during the last week of August 2025.

Data were collected through the "Institutions and Groups" module in SciVal, which provides access to institutional profiles, publication counts, citation metrics, and FWCI values. The extracted data were subsequently systematized in Microsoft Excel and analyzed using IBM SPSS Statistics, where all descriptive statistics, tables, and figures presented in this study were generated.

D. Statistical analysis

The distribution of the main bibliometric indicators—scholarly output, citations, citations per publication, and FWCI—was assessed for normality using the Shapiro–Wilk test. As none of the variables followed a normal distribution ($p < 0.001$), results are reported using medians and interquartile ranges (IQR) rather than means and standard deviations.

Given the characteristics commonly observed in bibliometric indicators—such as skewed distributions and the presence of extreme values—non-parametric statistical methods were employed. Group comparisons were conducted using the Mann–Whitney U test to evaluate differences in bibliometric indicators between universities with and without academic programs in mathematics, statistics, and mathematics education. This test was selected due to its robustness for comparing independent groups when the assumptions of normality are not met. In addition to statistical significance testing, effect sizes (r) were calculated to assess the magnitude of differences between groups.

III. Results

A. Descriptive overview of scholarly output and citation impact

To provide an initial overview of the data, histograms were generated for the distribution of scholarly output (Fig. 1) and FWCI (Fig. 2) across the 80 universities included in the study. These visualizations revealed highly skewed patterns, with most institutions exhibiting very low values and only a small group concentrating disproportionately high figures. In the case of scholarly output (Fig. 1), production in mathematics was heavily concentrated in a handful of universities—such as Pontificia Universidad Católica del Perú, Universidad Nacional de Ingeniería, Universidad Nacional Mayor de San Marcos, Universidad Continental, Universidad Tecnológica del Perú, and Universidad Nacional de San Agustín de Arequipa—while the majority of institutions published only a few papers.

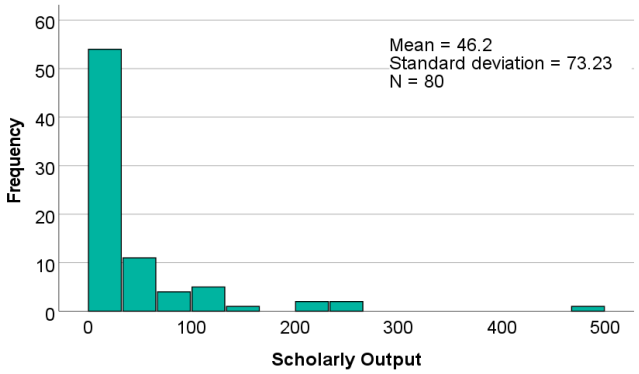

Fig. 1 Distribution of scholarly output in mathematics across Peruvian universities (2019–2024)
Source: SciVal (Scopus database)

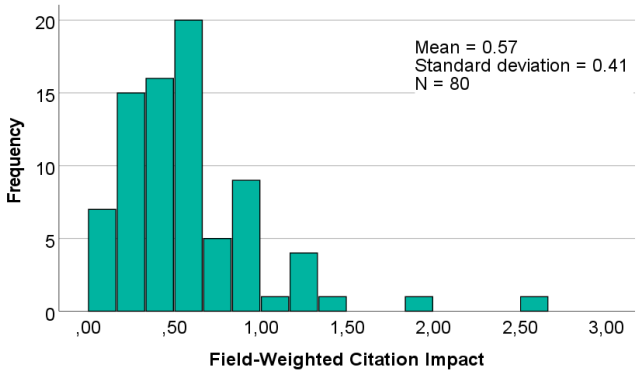

Fig. 2 Distribution of field-weighted citation impact in mathematics across Peruvian universities (2019–2024)
Source: SciVal (Scopus database).

Similarly, for FWCI (Fig. 2), most universities fell below the global benchmark of 1.0, indicating lower-than-expected citation rates, whereas a smaller number achieved outstanding relative impact, notably Universidad Peruana Unión, Universidad Ricardo Palma, Universidad Privada San Juan Bautista, and Universidad ESAN. These extreme values justify the use of non-parametric statistics and highlight the dual concentration of both productivity and impact in a limited subset of institutions.

B. Institutional differences by presence of specialized academic programs

Building on the descriptive patterns identified in the previous section, the following analysis examines whether the observed differences in mathematical scientific production are statistically associated with the presence of specialized academic programs. Table 1 summarizes the comparison of key bibliometric indicators between universities with and without academic programs in mathematics, statistics, and mathematics education. The analysis was conducted using the Mann–Whitney U test due to the non-normal distribution of the data.

The results revealed statistically significant differences in scholarly output between universities with and without academic programs in mathematics ($U = 343$, $p = 0.024$, $r = 0.25$) and between those with and without academic programs in statistics ($U = 252$, $p = 0.035$, $r = 0.24$), indicating small-to-moderate effect sizes. In both comparisons, institutions hosting these specialized academic units exhibited moderately higher median values of scholarly output in mathematics relative to universities without such academic programs. This suggests that, although statistically significant, the differences in research productivity between institutional groups are moderate in magnitude.

By contrast, no statistically significant differences were observed for scholarly output in relation to the presence of academic programs in mathematics education ($p > 0.05$).

Regarding citation-based indicators, no statistically significant differences were found between universities with and without academic programs in mathematics, statistics, and mathematics education for citations per publication or FWCI (all p-values > 0.05).

Given the absence of statistically significant differences in FWCI across institutional groups, a scatterplot was generated to explore the overall relationship between productivity and normalized citation impact (Fig. 3).

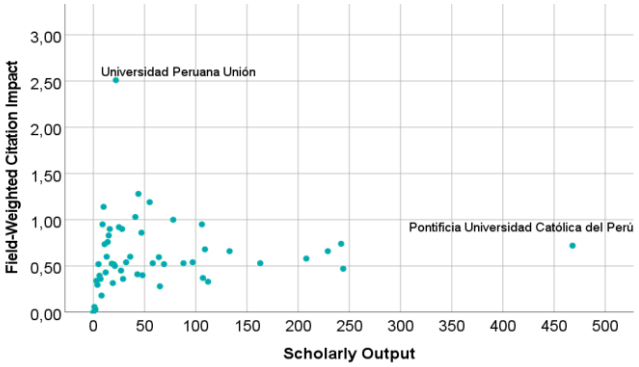

Fig. 3. Association between mathematical research output and field-weighted citation impact in Peruvian universities (2019–2024). Source: SciVal (Scopus database).

Spearman's correlation analysis revealed a moderate positive association between scholarly output and FWCI ($\rho = 0.481$, $p < 0.001$), indicating that while higher research output is generally associated with higher relative citation impact, substantial variability persists across institutions.

For total citations, the comparisons involving mathematics and statistics programs yielded p-values close to the conventional significance threshold ($p = 0.052$ and $p = 0.074$, respectively), although these differences did not reach statistical significance.

Beyond statistical significance, the descriptive statistics reported in Table 1 reveal substantial differences in the magnitude of research productivity across institutional groups. Universities hosting academic programs in mathematics exhibit notably higher median values of scholarly output compared to those without such programs, along with wider interquartile ranges, indicating greater dispersion in productivity levels. A similar pattern is observed for institutions with academic programs in statistics, which not only reach the highest median output values but also concentrate the most extreme observations.

In contrast, citation-based indicators display more stable distributions across the groups analyzed. Median values of citations per publication and FWCI remain relatively similar between universities with and without academic programs in mathematics, statistics, and mathematics education. This pattern suggests that while the presence of specialized academic programs is associated with higher volumes of scientific production, the normalized citation impact of publications remains comparable across institutional profiles. The broad interquartile ranges observed for these indicators further point to marked institutional variability within each group.

TABLE 1
COMPARISON OF BIBLIOMETRIC INDICATORS BY PRESENCE OF ACADEMIC PROGRAMS IN MATHEMATICS, STATISTICS, AND MATHEMATICS EDUCATION

Academic program		N	Scholarly output		Citations		Citations per publication		Field-weighted citation impact	
			Median	IQR	Median	IQR	Median	IQR	Median	IQR
Mathematics academic program	With	17	27	88	80	406	3.30	3.20	0.66	0.39
	Without	63	15	38	40	157	2.10	2.60	0.52	0.40
Statistics academic program	With	12	44	148	136	745	3.10	3.05	0.66	0.42
	Without	68	17	37	49	148	2.15	2.50	0.51	0.36
Math education academic program	With	17	22	38	65	154	2.50	2.40	0.52	0.49
	Without	63	18	48	54	160	2.20	2.80	0.52	0.42

Source: SciVal (Scopus database).

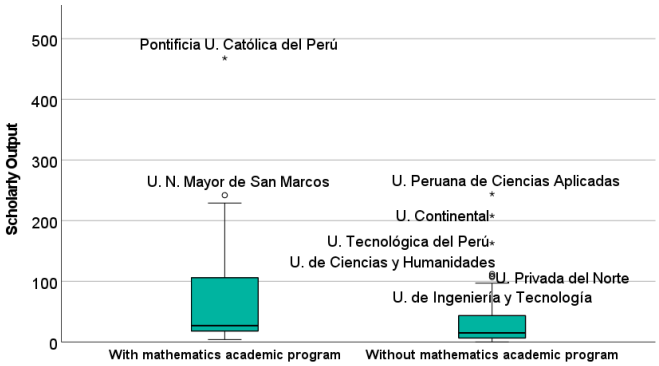

Fig. 4 Mathematics scholarly output across universities by presence of Mathematics academic programs (2019–2024).
Source: SciVal (Scopus database).

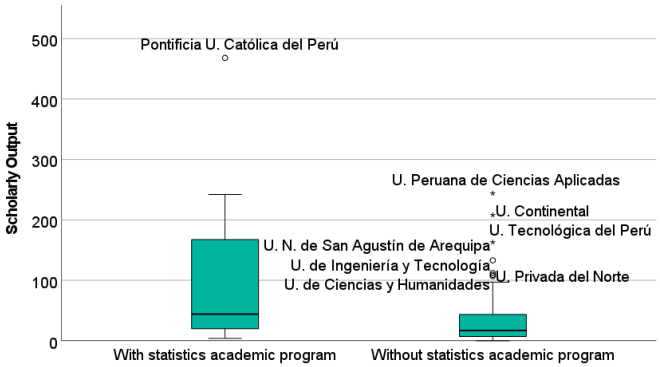

Fig. 5. Mathematics scholarly output across universities by presence of Statistics academic programs (2019–2024).
Source: SciVal (Scopus database).

To visually complement these results, boxplots were generated to compare scholarly output between universities with and without academic programs in mathematics and statistics (Figs. 4 and 5), following the statistically significant differences identified in the inferential analysis. The visualizations show higher median values and wider interquartile ranges for institutions hosting these programs, as well as the presence of outliers corresponding to universities with particularly high levels of scholarly output. In contrast, universities without such academic programs display lower median values and more compact distributions of scholarly output.

Given that the presence of mathematics education academic programs was not associated with significant differences in mathematical scholarly output, the following analysis focuses on universities with mathematics and/or statistics academic programs. Table 2 presents the ten Peruvian universities with the highest scholarly output in mathematics during the study period, together with selected institutional characteristics and research performance indicators. The results show that scholarly output is concentrated in a small number of institutions, most of which host formal academic units in mathematics and/or statistics, consistent with the productivity differences identified in the previous results. However, the presence of highly productive universities without such programs indicates that specialized academic structures, while relevant, are not a sufficient condition for high research output.

Additionally, FWCI values exhibit considerable variation across the ranked universities and do not follow the same pattern as publication volume, reinforcing the distinction between research productivity and normalized citation impact.

IV. DISCUSSION

Interpreting these findings within a broader bibliometric and institutional context, the results reveal a highly concentrated pattern of scientific production in mathematics across Peruvian universities, where a small group of institutions accounts for a substantial share of total output.

This pattern is consistent with international bibliometric evidence showing that academic productivity in higher education systems is typically uneven and strongly influenced by institutional capacity and strategic orientation [2], [7]. In this context, the statistically significant differences observed between universities with and without academic programs in mathematics and statistics suggest an association between the presence of these specialized academic programs and higher levels of research productivity. However, given the small-to-moderate magnitude of these differences, this relationship should be interpreted as limited rather than determinant.

Despite these differences in productivity, no significant variation was found in normalized impact indicators such as FWCI or citations per publication. This finding aligns with recent methodological discussions highlighting that FWCI, although more robust than raw citation counts, remains sensitive to field delineation and benchmarking procedures, which may mask qualitative differences across heterogeneous institutional contexts [8]. Consequently, the absence of FWCI differences should not be interpreted as equivalent research quality, but rather as a reflection of the limitations inherent in normalized metrics when applied to diverse academic systems.

TABLE 2
TOP 10 PERUVIAN UNIVERSITIES BY SCHOLARLY OUTPUT IN MATHEMATICS AND INSTITUTIONAL CHARACTERISTICS (2019–2024)

Rank	University	Type of management	Scholarly output	Total citations	FWCI	Mathematics-related academic programs
1	Pontificia U. Católica del Perú	Private	468	2295	0.72	Mathematics & Statistics
2	U. Peruana de Ciencias Aplicadas	Private	244	481	0.47	None
3	U. N. Mayor de San Marcos	Public	242	1096	0.74	Mathematics & Statistics
4	U. N. de Ingeniería	Public	229	1210	0.66	Mathematics & Statistics
5	U. Continental	Private	208	370	0.58	None
6	U. Tecnológica del Perú	Private	163	378	0.53	None
7	U. N. de San Agustín de Arequipa	Public	133	725	0.66	Mathematics only
8	U. de Ciencias y Humanidades	Private	112	168	0.33	None
9	U. de Ingeniería y Tecnología	Private	109	360	0.68	None
10	U. Privada del Norte	Private	107	213	0.37	None

Source: SciVal (Scopus database)

The lack of significant bibliometric differences associated with mathematics education academic programs further emphasizes the importance of institutional mission when interpreting research performance. Bibliometric and meta-review studies in mathematics education indicate that research in this field prioritizes pedagogical synthesis and professional practice over high-volume publication in disciplinary journals indexed in Scopus or Web of Science [6]. Therefore, the limited impact of these academic programs on mathematical scholarly output reflects their educational orientation rather than an absence of academic contribution.

The substantial heterogeneity observed among institutions, including outliers both with and without academic programs in mathematics and statistics, suggests that formal academic structures alone do not fully explain research performance. Studies on emerging and young universities highlight the relevance of complementary factors such as international collaboration, institutional incentives, infrastructure investment, and supportive research policies in enhancing productivity and visibility [9], [10]. Similarly, global bibliometric analyses emphasize that institutional leadership and collaboration networks often outweigh regional location in shaping academic output [11], which helps explain why institutional factors may outweigh geographic location in determining research performance.

Recent bibliometric research suggests that institutional differences in research performance are closely associated with academic mobility and collaboration dynamics rather than with formal organizational structures alone. Studies examining faculty mobility across institutions with unequal research capacity show asymmetric effects on productivity and impact, often resulting in a "moving penalty" for scholars embedded in resource-constrained environments and a cumulative advantage for those transitioning to research-intensive institutions. Evidence from historically under-resourced universities indicates that access to infrastructure, funding, and external collaboration networks may play a relevant role in sustaining publication output and citation impact [12].

Complementary findings from East Asian higher education systems further demonstrate that international and domestic research collaboration during academic careers has a stronger influence on productivity and normalized impact indicators than early-stage mobility or doctoral training abroad [13]. These insights provide a plausible contextual explanation for the absence of significant differences in FWCI observed in this study, which may reflect structural constraints and collaboration patterns rather than intrinsic differences in research quality across institutions.

Scientometric evidence from Latin American institutional contexts reinforces this interpretation. Studies analyzing research productivity in highly specialized academic organizations, such as university hospitals, reveal highly concentrated patterns of scientific output, where a limited number of institutions account for a disproportionate share of publications and citations. Although focused on a different disciplinary domain, these studies are analytically relevant because they examine research-intensive institutional settings, where productivity depends less on formal organizational structures and more on integration into international collaboration networks. Accordingly, international collaboration, access to external funding, and participation in global research networks consistently emerge as key determinants of productivity and visibility, frequently outweighing organizational size or geographic location [14]. In this sense, the concentrated pattern of mathematical research production observed among Peruvian universities aligns with broader regional dynamics, suggesting that structural integration into international scholarly networks may be more influential than the mere presence of academic programs in explaining institutional bibliometric performance.

V. Conclusions

This study provides a bibliometric assessment of scientific production in mathematics across licensed Peruvian universities using data from Scopus and SciVal for the period 2019–2024. The results reveal a highly concentrated research landscape, in which a limited number of institutions account for most of the scholarly output and relative citation impact in the field. This concentration highlights persistent asymmetries within the national higher education system.

A key finding of the study is that universities hosting academic programs in mathematics and statistics exhibit significantly higher—although moderately differentiated—levels of scholarly output. This result suggests an association between the presence of specialized academic programs and higher levels of scholarly output, although this relationship should be interpreted as moderate in magnitude and not necessarily indicative of a causal effect. However, these structures should be understood as part of a broader institutional ecosystem, in which factors such as research collaboration, academic mobility, access to research infrastructure, and supportive institutional policies also play a decisive role. The absence of significant differences in normalized impact indicators suggests that increased productivity does not necessarily translate into higher citation impact, reinforcing the distinction between research quantity and research quality in bibliometric evaluation.

By contrast, the presence of academic programs in mathematics education was not associated with differences in bibliometric performance, which can be attributed to their predominantly pedagogical orientation rather than to research in disciplinary mathematics. This finding emphasizes the need to interpret bibliometric indicators in light of institutional missions and disciplinary specificities.

Notwithstanding these contributions, this study presents certain limitations that should be acknowledged when interpreting the findings. First, the analysis relies exclusively on bibliometric data retrieved from Scopus and processed through SciVal, which, although widely used and internationally recognized, may underrepresent research outputs published in non-indexed journals or local outlets. Second, the use of aggregated institutional indicators limits the ability to capture qualitative dimensions of research performance, such as collaboration patterns, journal quality, authorship structures, or thematic specialization. Additionally, the analysis is based on bivariate comparisons and does not control for potential confounding factors such as institutional size, funding levels, governance type, or collaboration intensity, which may also influence research performance. Finally, the cross-sectional design covering the period 2019–2024 does not allow for the assessment of

temporal dynamics or causal relationships between institutional structures and research performance. These limitations suggest that the results should be interpreted as indicative rather than exhaustive, and they point to opportunities for future research to adopt complementary methodological approaches.

Overall, this study contributes empirical evidence to the literature on institutional determinants of scientific productivity in higher education within a Latin American context. Its findings may inform university managers and policymakers seeking to strengthen research capacity in mathematics through organizational development, strengthened collaboration mechanisms, and targeted institutional support. Future research could extend this analysis by incorporating collaboration networks, journal quality indicators, or longitudinal approaches to better capture the dynamics of research impact over time.

REFERENCES

[1] J. Arcila-Diaz, J. Delgado-Caramutti, P. A. Millones-Gómez, J. Figueroa-Quiñones, and A. Valencia-Arias, "Research trends in Peruvian universities: proposal for a research agenda with a bibliometric approach," *Scientometrics*, vol. 130, no. 1, pp. 489–514, Jan. 2025, doi: 10.1007/s11192-024-05211-z.

[2] R. Ruhita, "Measuring academic productivity in higher education: A bibliometric analysis of research output and scientific impact," *Indonesian Research Journal in Education*, vol. 9, no. 2, pp. 1213–1227, Dec. 2025, doi: 10.22437/irje.v9i02.48505.

[3] G. Rojas-Yauri, J. Castro-Bedriñana, D. Chirinos-Peinado, and T. Lagos-Quispe, "Análisis de la Producción científica Scopus 2019-2023 en Universidades Peruanas no Institucionalizadas en Comisiones Organizadora," *Revista General de Información y Documentación*, vol. 34, no. 2, pp. 363–375, Dec. 2024, doi: 10.5209/rgid.96142.

[4] J. V. Palomino-Flores and G. del P. Saravia-Ramos, "Engagement and scientific production at universities in Peru," *Revista InveCom*, vol. 5, no. 2, Apr. 2025, doi: 10.5281/zenodo.13926868.

[5] S.-R. Kienast, "How do universities' organizational characteristics, management strategies, and culture influence academic research collaboration? A literature review and research agenda," *Tertiary Education and Management*, vol. 29, no. 2, pp. 139–160, Jun. 2023, doi: 10.1007/s11233-022-09101-y.

[6] M. Cevikbas, G. Kaiser, and S. Schukajlow, "Trends in mathematics education and insights from a meta-review and bibliometric analysis of review studies," *ZDM – Mathematics Education*, vol. 56, no. 2, pp. 165–188, May 2024, doi: 10.1007/s11858-024-01587-7.

[7] D. Jamali, G. Samara, and L. I. Meho, "Determinants of research productivity and efficiency among the Arab world's accredited business schools," *Management Review Quarterly*, vol. 74, no. 4, pp. 2511–2543, Dec. 2024, doi: 10.1007/s11301-023-00365-1.

[8] N. Scelles and J. A. Teixeira da Silva, "Making the impact of publications within a field comparable by improving the field-weighted citation impact (FWCI): the case of sport management," *Scientometrics*, vol. 130, no. 3, pp. 1571–1586, Mar. 2025, doi: 10.1007/s11192-025-05268-4.

[9] N. G. Mushagalusa *et al.*, "Utilizing scientometric analysis to evaluate indicators of quality research at the institutional level: A case study of UEA, a young Central African university," *Social Sciences & Humanities Open*, vol. 10, p. 100974, 2024, doi: 10.1016/j.ssaho.2024.100974.

[10] B. Kim, Y. Beom-Jong, S. Hyoung-Seop, and K. Jihoon, "National and international research collaboration network in South Korea: An analysis of library and information science journals (2015–2024)," *Malaysian Journal of Library and Information Science*, vol. 30, no. 1, pp. 31–57, May 2025, doi: 10.22452/mjlis.vol30no1.2.

[11] C. You, S. R. Awang, and Y. Wu, "Bibliometric analysis of global research trends on higher education leadership development using Scopus database from 2013–2023," *Discover Sustainability*, vol. 5, no. 1, p. 246, Sep. 2024, doi: 10.1007/s43621-024-00432-x.

[12] X. Zheng, E. Yan, and C. Ni, "Faculty mobility and research dynamics at Historically Black Colleges and Universities," *Quantitative Science Studies*, vol. 5, no. 4, pp. 844–860, Nov. 2024, doi: 10.1162/qss_a_00334.

[13] J.-Y. Chu, S.-Y. Chiu, and Y.-S. Syu, "Returnee and local doctorates on research productivity: doctoral training, international mobility, and research collaboration," *High. Educ. (Dordr).*, vol. 87, no. 4, pp. 963–989, Apr. 2024, doi: 10.1007/s10734-023-01046-4.

[14] J. C. Tocora, A. E. Gracia-Ramos, and D. A. Forero, "A Scientometric Analysis of Research Productivity in Clinics and Hospitals from Five Latin American Countries," *Journal of Scientometric Research*, vol. 13, no. 1, pp. 103–112, Apr. 2024, doi: 10.5530/jscires.13.1.9.