



INDICATORS OF RESEARCH, PUBLICATION AND INTERNATIONALIZATION IN THE ANDEAN UNIVERSITIES BEHAVIOR

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Abstract

The existence of studies on the composition of indicators based on SCIMAGO and QS in their behavior towards the first Andean universities that are part of the Andean parliament, involves some different composition elements for each indicator in terms of regression statistics, which corroborate the correlation and trend of the composite indices, pointing to similar leadership behaviors by countries such as the United States and China at a global level, added to the potential growth of India with respect to the ranking of Andean universities that lead such as Colombia and Chile with a margin and growth of Peru, Ecuador and Bolivia in the ranking, where the nations belonging to the Andean Parliament added universities to the SCIMAGO ranking and to a very small extent to the QS.

Keywords: Indicators, Andean universities, ranking.

INTRODUCTION

Most studies of international collaboration have focused on specific periods, research fields, countries, or geographic areas. (Aksnes and Sivertsen, 2023). From the studies it can be seen that international collaboration between universities, many times are focused on research projects where they seek to have strategic alliances for the results publications of these investigations.

Universities play a role in generating and transmitting knowledge. Therefore, it is important to identify their levels of collaboration and trends in lines of technological application, in order to establish future development policies in this sector. (Agüero, 2017).

In universities, it is important to carry out research about their organizational culture as the central axis of knowledge management and to be able to develop strategies that allow them to maintain and position themselves in the future. (Mata Ordaz and Pesca de Acosta, 2011). Universities have the main role in becoming intellectual centers that seek solutions to the different problems that research professors generally pose in their research projects.

Among various aspects of policies that induce international scholarly collaboration, the requirement to publish in international peer-reviewed journals is the main policy tool employed on national and institutional levels in developing countries. (Moldashev & Tleuov, 2022). So publications are the way in which universities can strengthen research, meeting the requirements that each of the journals demand, this also strengthens internationalization.

Universities have been strengthening the internationalization of education through publications, where they have often received funds from other institutions through requirements compliance that seek to ensure that their professors productivity is of quality. Some institutions might be in more privileged positions to receive external funds than others. The same is true for specific fields of study



and research topics. The demanding research productivity requirements along with costly research activities prompt researchers to secure financial resources. (Niemczyk & Rónay 2023)

The number of publications of a research professor is an important indicator of the contribution to the academic community and can have a significant impact on their students, however, it is important to note that the quality and relevance of publications are also critical factors to consider, not just quantity. The number of publications of a researcher is the basis for many evaluations of higher education institutions, such as the progression in academic career, receiving support for performing and continuing researches, scores for master and PhD programs... (Ribeiro & Aroni, 2019)

There may also be a considerable gap between the conceptualization of a research result and its actual publication. (Deutz et al., 2021). Consequently, the research process and its subsequent publication do not always occur immediately, and there may be a considerable period of time between the idea conception and its availability to the academic community in a publication in the categorized journals.

Hence, we can see the great influence that science and technology indicators have gained around the world, oriented to account for the relationship between resources invested and products obtained at the level of individuals, institutions, and countries. (Algañaraz et al., 2023). The production of research results in universities has been taking on an increasingly recognized value and is expected to contribute to the development, improving research and creating opportunities in various contexts, also for this reason, indicators have also been generated not only for research, but also to measure publication rates, at the same time that internationalization is strengthened.

Science has experienced significant growth in the production of knowledge because research professors have been publishing and this increase has been especially notable due to the collaboration between groups and communities of researchers that contribute to this knowledge. The scientific production of universities reveals their capacity to fulfill one of their most fundamental functions: the creation of new knowledge. (Santin et al., 2015)

Thanks to this exponential increase in the production of knowledge that universities have been promoting, terms such as internationalization and publications have become part of academic terms, which are strengthening the repositories and databases of university libraries.

It constitutes one of the aspects that is most prioritized in the current scientific performance evaluation systems in universities and science and technology councils, and one of the objectives sought from the information and legitimation systems of written science, such as large repositories and databases. (Aguado-López et al., 2016)

Publication patterns and collaboration in the area are assessed according to the publication of articles in international journals and collaboration with authors from other countries, respectively. (Santin et al., 2016). It is verified how the indicators that can be taken in the research and publication process that strengthen internationalization are quality and visibility of publications in categorized journals, in turn, it also strengthens international collaboration between research professors.

It is essential to obtain indicators that allow us to study whether the internationalization of Higher Education had an impact on the impact and visibility of the production produced in international collaboration. (de Souza, 2020). Indicators are necessary because they are used to measure the contribution and impact of research in the field in question, mainly evaluating publications in international journals and collaboration with authors from other countries, respectively.

Internationalization in academic spaces has traveled and still covers different terrains, all of them interconnected, in which postgraduate training, the mobility of teachers and researchers and scientific production could be categorized as the main ones. (Liberatore et al., 2021). It is essential that teaching mobility is carried out, this is carried out by universities that have ambitious policies and stable budgets, thus presenting academic power and recognition.

The indicators help evaluate the degree of openness and collaboration of the scientific community in a certain field or region, this allows a high percentage of research professors to have a high average of publications with international collaboration. Two indicators for international collaboration are used: The share of researchers involved in international collaboration measured by coauthorship and the average proportion of publications with international collaboration per researcher. (Rørstad et



al., 2021)

METHODOLOGY

Definition and Operationalization of Variables

In a metrics scenario, quantitative variables are extremely convenient, in this order, Hernández Sampieri, (2014) refers to the variables as a set of procedures that describe the activities that an observer must perform to receive sensory impressions that indicate the existence of a theoretical concept to a greater or lesser degree, thus specifying what activity or activities should be carried out to measure a variable even when several are possible, the operational definition for the same variable, in this way, the place or position occupied by a Higher Education Institution in a recognized ranking is of high value, which is why the variables (rankings) included for this correlational analysis are:

Table 1 Definition and Operationalization of Variables

Variable	Definition	Operationalization
SCImago ranking	Publicly available ranking that involves journals and scientific indicators of countries based on the information contained in the Scopus® database (Elsevier B.V.). indicators that can be used to evaluate and analyze scientific domains. Which, among others, considers elements such as: <ul style="list-style-type: none"> ● H-index ● Cites per Document (CPD) ● Collaboration index ● Self-citations As a contribution, this index contributes to the internationalization of academic and scientific research being useful from a perspective with greater focus on the substantive function of research universities.	Position in the Scimago ranking based on citations received by the journals in a period of 3 years, giving greater weight to citations from highly prestigious journals based on the Google PageRank algorithm.
Quacquarelli Symonds RANKING (QS)	Ranking that measures from a system of evaluating the performance of universities in various areas: <ul style="list-style-type: none"> ● Academic reputation ● Employer reputation ● Teacher / Student ratio ● Citations ratio per research staff ● International teachers ratio / International students relation ● International Research Network ● Result in employability ● Sustainability This index potentially contributes in a greater way to the internationalization of Institutions	Position in the ranking based on the six key indicators of its composition

For Hernández Sampieri, (2014) Spearman's rho coefficients, symbolized as rs, and Kendall's tau,

symbolized as t , are correlation measures for variables at an ordinal measurement level (both), in such a way that the individuals, cases or units of analysis of the sample can be ordered by ranges (hierarchies).

RESULTS AND DISCUSSION

Map 1. Andean Universities SCIMAGO Ranking 2023 - Intraregional quantity.



Source: Own elaboration based on SCIMAGO 2023

First part of this analysis can collect several results, which even without having reached the development of the model, already foresee certain decision directions such as the undisputed leadership of the United States and China at a global level, added to the ever-present growth of India.

Regarding the region, Brazil, which leads by a very wide margin in its contribution to the ranking, to the point that the four most significant nations are required to equal its participation, finally, in this section it is worth analyzing the Andean subregion, in which Colombia and Chile undisputedly lead, however, the growth of Peru and Ecuador, which envision a potential future.

Finally, and although it is true, as of 2020 Bolivia appeared with one university in the ranking, the lag of this nation compared to its Andean peers and even more so to the rest of the Latin American region is still worrying.

Additionally, the nations belonging to the Andean Parliament added HEIs to the SCIMAGO ranking, where Colombia stands out in terms of quantity, registering 51 universities by 2023, for its part, Chile holds the highest places with the University of Chile and the Pontifical Catholic University of Chile; In the case of Peru, a significant increase is recorded with a variation of 44%, going from five HEIs in 2019 to 27 in 2023. Finally, Bolivia stands out for its lag behind its partners, registering only one university in this list.

Table 2 Andean Universities SCIMAGO Ranking 2023

AÑO	CHILE	COLOMBIA	PERÚ	ECUADOR	BOLIVIA	TOTAL AND	TOTAL LAT	%
2019	32	31	5	12	0	80	288	28%
2020	35	36	9	16	1	97	317	31%
2021	35	43	13	21	1	113	344	33%
2022	41	45	17	24	1	128	388	33%
2023	42	51	27	21	1	142	418	34%
VARIACIÓN (AUMENTO)	31%	65%	440%	75%	0%	78%	45%	

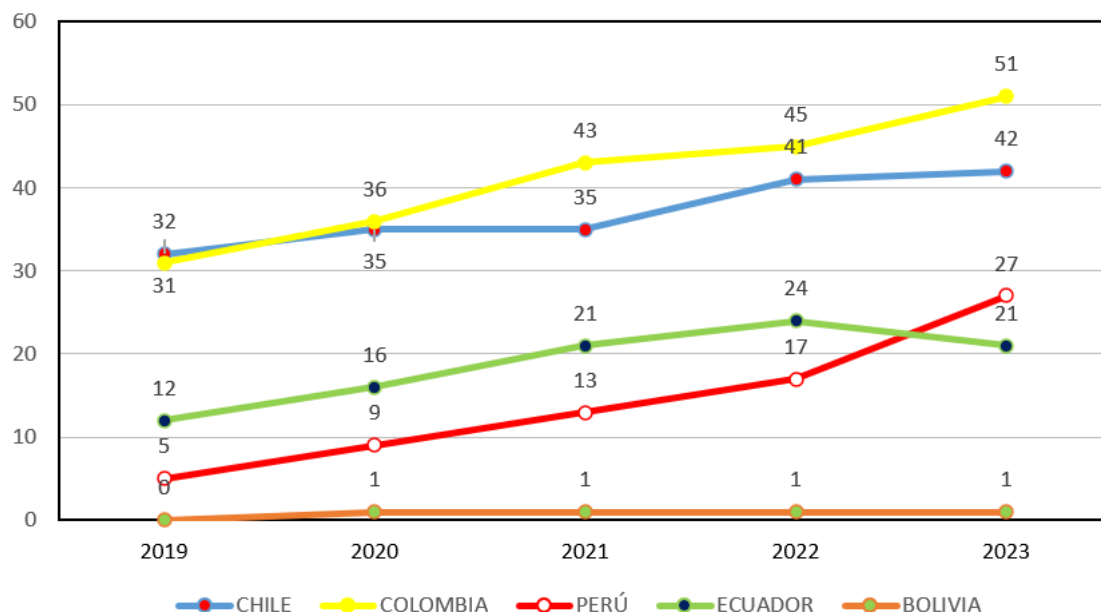
Source: Own elaboration based on SCIMAGO 2023

Universities of the member countries of the Andean Parliament increased their presence in the SCIMAGO ranking by 78% from 2019 to 2023, contributing an average of a third of the Latin American



registry. See figure 1.

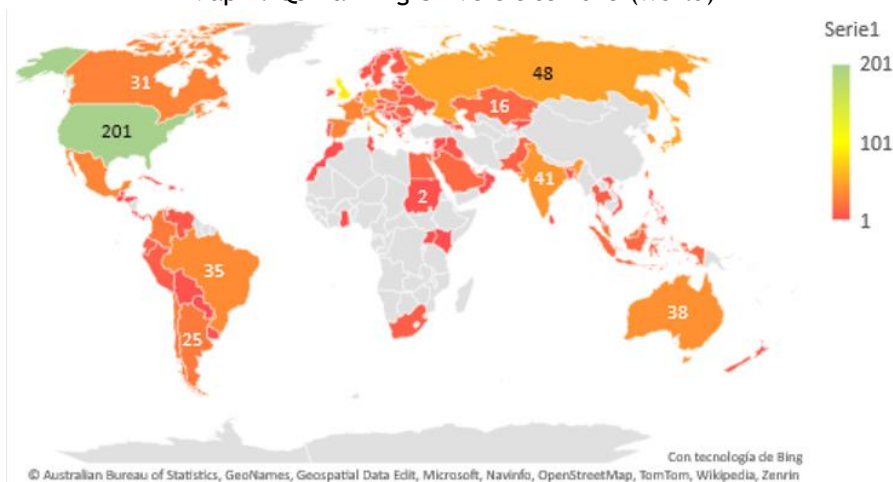
Figure 1. Growth in the number of Universities in Andean countries in Latin America SCIMAGO Ranking (2019-2023)



Source: Own elaboration based on SCIMAGO 2023

Regarding the findings in the QS ranking, and similarly to the previous exercise with the SCIMAGO ranking, 1,422 Higher Education Institutions were included worldwide, among which the United States of America once again leads, followed by the United Kingdom and China.

Map 2. QS Ranking Universities 2023 (world)



Source: Own elaboration based on QS 2023

Regarding Latin America, the dominance of Brazil persists, which, although on this occasion it is not as marked or distant as in the SCIMAGO ranking, maintains the leadership in the region followed by Mexico, Argentina and Colombia. We immediately proceed to correlate using the Spearman finding method. See table 3.

Table 3 Correlations Top 10 Universities in the Andean subregion in SCIMAGO ranking 2019-2023

			AÑO2023	AÑO2022	AÑO2021	AÑO2020	AÑO2019
Rho de Spearman	A	Coef. Correlación	1,000	,952**	,939**	,927**	,939**
	Ñ						
	O	Sig. (bilateral)	.	,000	,000	,000	,000
	20	N	10	10	10	10	10
	23						
	A	Coef. Correlación	,952**	1,000	,988**	,939**	,964**
	Ñ						
	O	Sig. (bilateral)	,000	.	,000	,000	,000
	20	N	10	10	10	10	10
	22						
	A	Coef. Correlación	,939**	,988**	1,000	,952**	,976**
	Ñ						
	O	Sig. (bilateral)	,000	,000	.	,000	,000
	20	N	10	10	10	10	10
	21						
	A	Coef. Correlación	,927**	,939**	,952**	1,000	,988**
	Ñ						
	O	Sig. (bilateral)	,000	,000	,000	.	,000
	20	N	10	10	10	10	10
	20						
	A	Coef. Correlación	,939**	,964**	,976**	,988**	1,000
	Ñ						
	O	Sig. (bilateral)	,000	,000	,000	,000	.
	20	N	10	10	10	10	10
	19						

** . Correlation is significant at the 0.01 level (two-sided).

Source: Own elaboration based on SCIMAGO 2019-2023 - IBM SPSS

This is how it is conclusively concluded that the top ten universities in the Andean subregion tend to maintain their places in the region (Latin America) without major changes, a fact that will have to be corroborated when reducing this analysis for the five South American countries, who are part of the Andean parliament:

Table 4 Top 10 Universities in the Andean subregion in SCIMAGO ranking 2019-2023 (Andean countries)

#	Institution	2019	2020	2021	2022	2023
1	Pontificia Universidad Católica de Chile	2	1	2	1	1
2	Universidad de Chile	1	2	1	2	2
3	Universidad Nacional de Colombia	3	3	3	3	3
4	Universidad de Antioquia	6	6	4	4	4
5	Universidad de Concepción	7	5	6	6	5
6	Pontificia Universidad Javeriana *	9	7	5	5	6
7	Universidad de los Andes, Colombia *	10	10	7	7	7
8	Pontificia Universidad Católica de Valparaíso	20	19	15	8	8
9	Universidad de Talca *	16	14	13	9	9
10	Universidad Austral de Chile *	14	13	8	10	10

Source: Own elaboration based on SCIMAGO 2019-2023



Table 5 Top 10 Universities in the Andean subregion ranking SCIMAGO vs QS (Latin America location)

Institution	SCIMAGO 2023	QS 2023
<i>Pontificia Universidad Católica de Chile *</i>	7	4
<i>Universidad de Chile *</i>	9	5
<i>Universidad Nacional de Colombia *</i>	10	9
<i>Universidad de Antioquia *</i>	15	32
<i>Universidad de Concepción *</i>	17	30
<i>Pontificia Universidad Javeriana *</i>	26	13
<i>Universidad de los Andes, Colombia *</i>	29	8
<i>Pontificia Universidad Católica de Valparaíso</i>	35	46
<i>Universidad de Talca *</i>	42	91
<i>Universidad Austral de Chile *</i>	48	85

Source: Own elaboration based on SCIMAGO and QS 2023

The results point to a correlation of 0.818, which is a high relationship despite involving some different composition elements for each indicator. See table 6.

Table 6 Correlations Top 10 Andean subregion universities ranking

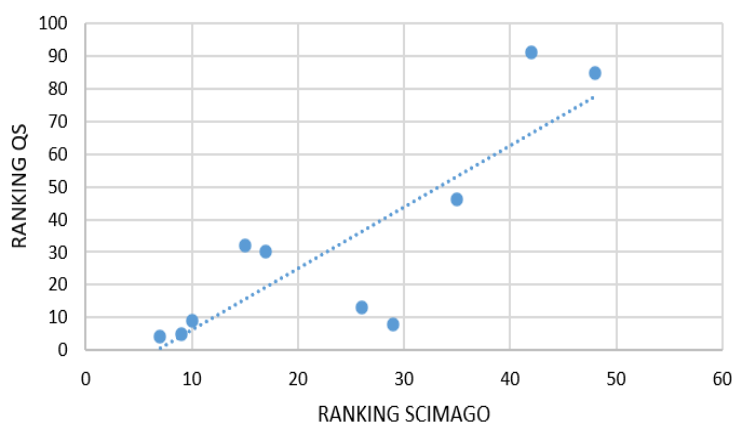
SCIMAGO vs QS (ubicación Latinoamérica)			RANKSCIMA GO2023	RANKQS2023
Rho de Spearman	RANKSCIMAGO2023	Coeficiente de correlación	1,000	,818**
		Sig. (bilateral)	.	,004
		N	10	10
	RANKQS2023	Coeficiente de correlación	,818**	1,000
		Sig. (bilateral)	,004	.
		N	10	10

** . The correlation is significant at the 0.01 level (two-sided).

Source: Own elaboration based on SCIMAGO and QS 2023 - IBM SPSS

Regarding the regression statistics, a strong positive correlation of 0.818 is corroborated, pointing to a positive linear trend in which the two indices, despite being composed in different ways, point to similar behaviors, as presented in the scatter graph. See figure 2.

Figure 2. Scatter graph of top 10 Andean subregion universities in SCIMAGO and QS ranking based on their location in Latin America



Source: Own elaboration based on SCIMAGO and QS 2023

Taking these results as a starting point, a similar or even more solid trend should be expected for the countries of the subregion, in this way, the ten universities that lead the SCIMAGO ranking for 2023 in this part of South America are taken up again, on this occasion from its position as such in the

subregion to be compared with its position in the QS ranking for the same year, by this way the data is recorded in the table.

Table 7 Top 10 Universities in the Andean subregion ranking SCIMAGO vs QS (Andean subregion location)

<i>Institution</i>	<i>SCIMAGO 2023</i>	<i>QS 2023</i>
<i>Pontificia Universidad Católica de Chile *</i>	1	1
<i>Universidad de Chile *</i>	2	2
<i>Universidad Nacional de Colombia *</i>	3	4
<i>Universidad de Antioquia *</i>	4	10
<i>Universidad de Concepción *</i>	5	8
<i>Pontificia Universidad Javeriana *</i>	6	6
<i>Universidad de los Andes, Colombia *</i>	7	3
<i>Pontificia Universidad Católica de Valparaíso</i>	8	16
<i>Universidad de Talca *</i>	9	31
<i>Universidad Austral de Chile *</i>	10	28

Source: Own elaboration based on SCIMAGO and QS 2023

Taking into account the previous table, Colombian and Chilean universities lead and dominate the top ten for andean Higher Education Institutions, performing a high performance into the SCIMAGO 2023 and QS 2023 rankings. Besides, at first view, great changes in rankings are not observed highlighting first positions of Pontificia Universidad Católica de Chile and Universidad de Chile maintaining a leadership on this rank.

CONCLUSIONS

There is leadership by the United States and China at a global level added to the potential growth of India, with respect to the ranking of the Andean subregion, Colombia and Chile lead with a margin and growth of Peru, Ecuador and Bolivia with a university in the ranking, where the nations belonging to the Andean Parliament added IES to the SCIMAGO ranking, highlighting Colombia with a considerable number of universities where Chile occupies the highest place with the University of Chile and the Pontifical Catholic University of Chile, the Universities of the member countries of the Andean Parliament increased their presence in the SCIMAGO ranking from 2019 to 2023, contributing on average a third of the Latin American record, in the same way as the QS ranking, at a global level, new higher education institutions were included, led by the United States of America, the United Kingdom and China; in Latin America, the dominance of Brazil persists, in the SCIMAGO ranking followed by Mexico, Argentina and Colombia.

The correlation is high despite involving some different composition elements for each indicator from SCIMAGO and QS, regarding the regression statistics, a strong positive correlation is corroborated, pointing to a positive linear trend in which the two indices, despite being composed in different ways, point to similar behaviors. The top ten universities in the Andean subregion tend to maintain their places in the region (Latin America) without major changes, fact that is corroborated when reducing this analysis for the five South American countries that are part of the Andean parliament, where the dispersion of the top 10 Andean subregion universities in SCIMAGO and QS ranking based on their location at the Latin American level, taking as a starting point, a similar or even more solid trend is observed for the countries of the subregion. In this way, the ten universities are taken up again. that lead the SCIMAGO ranking in this part of South America on this occasion from their position as such in the subregion to be compared with their position in the QS ranking for the same year.

Finally, it should be noted that in order to evaluate research, publications and internationalization jointly, the use of the two proposed indicators was unavoidable due to their versatility and construction that comprehensively involve these elements and not in isolation as other indicators do that could potentially have yielded autocorrelation results, subtracting significance and credibility

from the results presented here, passing from a discussion far from chance to concrete and methodologically useful elements.

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