Analysis of Patterns in the University World Rankings Webometrics, Shanghai, QS and SIR-SCimago: Case Latin America

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Abstract. The internationalization and positioning of universities offers relative comparisons, studied according to different teaching and research criteria. Among the recognized rankings are the Academic Ranking of World Universities (ARWU) or Ranking of Shanghai, QS World University Ranking, SCimago Institutions Rankings SIR and the Web Ranking of Universities-Webometrics. Comparatively, characteristics of each one are presented in terms of scope, volume of universities positioned and evaluation criteria. The indicators associated with research and institutional capacity stand out as common criteria in the revised evaluation methodologies. Regarding Latin America, Brazil leads with its presence in the four rankings. There is a greater number of Latin American universities in QS (40%) and Webometrics (31%), in the other two rankings it does not exceed 8%.

Keywords: Ranking university · Webometrics · QS · SCimago Shanghai

1 Introduction

For reasons of internationalization, competitiveness and others, monitoring the relative positioning of universities in the Ranking has become a daily practice. The essence of internationalization is the dissemination and communication of knowledge that is created within the universities, the opening to the world and the enrichment of the staff as a result of the encounter with other cultures [1, 2], guiding the teaching production and researcher towards an international profile, improving its recognition and visibility [3, 4]. The Rankings establish comparisons between universities according to quality or excellence criteria considering attributes related to internationalization requirements. In this sense, there is no consensus on what is considered "quality" or "excellence" in university education and its visibility [4, 5] motivated that it is a multidimensional concept, which

Y. Tan et al. (Eds.): DMBD 2018, LNCS 10943, pp. 188–199, 2018.
https://doi.org/10.1007/978-3-319-93803-5_18

complicates monitoring and control of the activities that may impact on improving the positioning. This is how various authors have questioned the Rankings because they are based on measurements of heterogeneous information [6], however others claim that the presence and visibility on the web and, especially, that of their scientific production, contributes significantly to its international positioning [7–9].

Currently, the positioning of universities is determined in terms of the quality of education, research and other aspects of academic activity. The rankings have multiplied in recent years and offer a hierarchical order of the universities based on a consensus assessment methodology. They are used to promote educational policies and encourage the quality of University Education, in addition to attracting students and resources. These positioning lists order universities with specific models considering various bibliometric and cybernetic indicators. The specialized literature reports various systems of positioning for higher education institutions, attending heterogeneous evaluation criteria. Some mostly focused on research, others on academic quality or visibility and impact on the web.

Among the recognized rankings are the Academic Ranking of World Universities (ARWU) or Ranking of Shanghai, QS World University Ranking, SCimago Institutions Rankings SIR and the Web Ranking of Universities-Webometrics. The purpose of these is to organize the universities according to indicators that should reflect their capacity as an institution, quality of academic activities, production and dissemination of research, innovation and relations abroad of universities. They are also used to make decisions, from the distribution of research funds to the desired profiles of teachers and researchers. Knowing the characteristics of the rankings offers valuable information for the definition of strategies for the international positioning of universities. This work describes each of these rankings to make comparisons regarding its scope of evaluation and its impact in Latin America.

2 Methodology

Although the university rankings QS, SIR-SCimago, Webometrics and Shanghai present differences and have been questioned for their evaluation criteria and heterogeneity, in this article a descriptive and comparative analysis is made regarding their application, evaluation indicators and weights, under the following steps:

1. Data were collected in the respective web pages of the rankings regarding:
   - Institution and country where the ranking is published.
   - Year of beginning of the publication of the ranking.
   - Frequency of publication of the ranking.
   - Year of publication of the last edition.
   - Number of years with (historical) data of published rankings.
   - Number of universities positioned worldwide in the last publication.
   - Number of evaluation indicators used.
   - Regarding Latin America: Number of Latin American universities positioned, Number of Latin American countries with universities positioned in the last publication, Number of universities per Latin American country.

2. The evaluation criteria and indicators of each ranking are compiled with their respective weights.
3. The indicators are grouped according to criteria and areas of application to observe comparatively the weights given to them:

   Academic quality: academic prestige achieved by international awards, academic reputation.
   Research: publications made as results of the research, dissemination in index, citations.
   Innovation: technological applications made through patents, publications associated with patents.
   Community: relationship of the university with the community through the perceived reputation of the employers, in addition to the web visibility achieved by the links to its institutional portal.
   Capacity of the institution: Number of staff, number of web pages in its portal, capacity of internationalization of the university with respect to its teachers and students.

4. Identification of Latin American TOP10 universities in each ranking.

3 Development

3.1 Academic Ranking of World Universities (ARWU) of Shanghai

The Academic Ranking of World Universities (ARWU) was first published in June 2003 by the World Class University Center (CWCU) of Jiao Tong University in Shanghai, China; updated annually. ARWU uses six (6) objective indicators to classify the world's universities [9, 10]. As of 2017, universities classified between 501 and 800 are also published as ARWU World Top 500 Candidates. The highest scoring institution is assigned a score of 100 and the rest are calculated as a percentage of the maximum score. Table 1 briefly describes their indicators.

3.2 QS World University Ranking

Published since 2004 with an annual periodicity, and considers academic, employer, student and international indicators. The 2018 publication contains 959 universities around the world and is based on the opinions of more than 75,000 academics, 40,000 employers, as well as 12.3 million research papers and 75.1 million citations [11]. Among the aspects to be measured are the citations received, the student-teacher ratio, the proportion of international students and foreign professors, the academic reputation, the reputation among employers, and personnel with a doctorate [12] (Table 2).

3.3 SCimago Institutions Rankings (SIR)

The SIR SCimago Ranking begins in 2009 conducted by the Spanish SCimago research group and is called SCimago Institutions Rankings (SIR). Its periodicity is

annual and for the last edition published in the year 2017 it publishes a list of 2,966 universities positioned in the world [12]. This evaluates only the research around the publications that are in the Scopus database [11], based on the indicators the Table 3.

Table 1. Evaluation indicators applied in the Ranking of Shanghai.

Criteria	Indicator	Code	Weigh
Quality of education	Total number of alumni of an institution that won Nobel prizes and Fields medals. Students are defined as those who obtain bachelor's, master's or doctoral degrees from the institution. The different weights are established according to the degrees obtained. Source: http://nobelprize.org/	Alumni	10%
Quality of faculty	Total number of staff of an institution that wins the Nobel Prizes in Physics, Chemistry, Medicine and Economics and the Fields in Mathematics Medal. The staff is defined as those who work in an institution when winning the prize. Source: http://www.mathunion.org/index.php?id=prizewinners	Award	20%
	Number of highly cited researchers selected by Clarivate Analytics (Highly Cited Researchers HCR). Source: https://clarivate.com/hcr/	HiCi	20%
Research output	Number of articles published in Nature and Science. To distinguish the order of affiliation of the author, a 100% is assigned for the affiliation of the author of correspondence, 50% for the affiliation of the first author, 25% for the next author affiliation and 10% for other author affiliations. Source: http://www.webofscience.com/	N&S	20%
	Total number of articles indexed in Science Citation Index-Expansion and Social Science Citation Index. Source: http://www.webofscience.com/	PUB	20%
Per Capita performance	Weighted scores of the five previous indicators divided by the amount of full-time equivalent academic staff. If the number of academic staff cannot be obtained for the institutions of a country, the weighted scores of the five previous indicators are used.	PCP	10%

Table 2. Evaluation indicators applied in the QS Ranking

Criteria	Indicator	Code	Weight
Academic reputation	Based on the *Academic Survey*, it collates the expert opinions of over 70,000 individuals in the higher education space regarding teaching and research quality at world's universities	ACAR	40%
Employer reputation	Is based on over 30,000 responses to the *QS Employer Survey*, and asks employers to identify those institutions from which they source the most competent, innovative, effective graduates	EMPR	10%
Faculty/Student Ratio	The measuring teacher/student ratios is the most effective proxy metric for teaching quality. It assesses the extent to which institutions are able to provide students with meaningful access to lecturers and tutors, and recognizes that a high number of faculty members per student will reduce the teaching burden on each individual academic	F/STD	20%
Citations per faculty	The total number of citations received by all papers produced by an institution across a five-year period by the number of faculty members at that institution. All citations data is sourced using Elsevier's *Scopus* database.	CIT	20%
International faculty ratio/International student ratio	A highly international university acquires and confers a number of advantages. It demonstrates an ability to attract faculty and students from across the world, which in turn suggests that it possesses a strong international brand. Both of these metrics are worth 5% of the overall total	INT/R	5% + 5%

Table 3. Evaluation indicators applied in the Ranking SIR SCimago

Criteria	Indicator	Code	Weight
Research 40%	Excellence with Leadership: indicates the amount of documents in Excellence in which the institution is main contributor	Ewl	13%
	Normalized Impact: Is computed over the institution's leadership output the methodology established by the Karolinska Institute in Sweden. The normalization of the citation values is done on an individual article level	NI	13%
	Output: Total number of documents published in scholarly journals indexed in Scopus	O	8%
	Scientific talent pool: Total number of different authors from an institution in the total publication output of at institution during a particular period of time	STP	5%
	Scientific Leadership: The amount of an institutions's output as main contributor. Amount of papers in which the corresponding author belongs to the institution	L	5%
	International Collaboration: Institution's output produced in collaboration with foreign institutions	IC	2%
	High Quality Publications (Q1): Number of publications in the most influential scholarly journals of the world, ranked in the first quartile (25%) in their categories as ordered by SCimago Journal Rank (SJRII)	Q1	2%
	Exellence: The amount of an institution's scientific output that is included in the top 10% of the most cited papers in their respective scientific fields	Exc	2%
Innovation 30%	Innovative Knowledge: Scientific publications output from a institutions cited in patents. Based on PATSTAT.	IK	25%
	Technological Impact: Percentage of the scientific publication output cited in patents	TI	5%
Societal 20%	Domain's inbound links: Number of incoming links to an institution's domain according to ahrefs	IL	15%
	Web size: Number of pages associated to the institution's URL according to Google	WS	5%

3.4 Web Ranking of Universities-Webometrics

The Webometrics Ranking has been carried out since 2004 by the Higher Council for Scientific Research (CSIC), Spain, published two (2) times a year, at the end of January and July. For the publication of January of the year 2018, 12,005 universities were classified worldwide [13]. This realizes the ranking of the universities based on four (4) indicators that assess the presence, impact, excellence and openness in the web [14]. In this sense, Table 4 shows the definitions of each of these indicators.

As can be seen, the criteria established to prepare the Rankings are far from being homogeneous among the different evaluation criteria. In Table 5, the four rankings are presented in a comparative way. As shown in Table 6, the most important factor is the research function, which in the case of the SIR-SCImago Ranking corresponds to 50%.

Table 4. Evaluation indicators applied in the Ranking Webometrics

Criteria	Sub criteria	Indicator	Code	Weight
Visibility 50%	Impact	It is evaluated through a "virtual referendum", counting all the incoming links received by the university web domain of third parties, both academic and not	VIS	50%
Activity 50%	Presence	Total number of web pages hosted in the main web domain of the university obtained by Google	PRES	16.6%
	Opening	The institutional repositories of research are explicitly recognized in this indicator, taking into account the total number of rich files (pdf, doc, docx, ppt), published on websites collected by Google Scholar	APER	16.6%
	Excellence	Articles between the 10% most cited of their respective scientific disciplines, is a measure of the high quality production of the research institutions, taken from the SCImago Group	EXC	16.6%

4 Results and Analysis

Table 5 shows the comparison of the (4) Ranking according to the global and Latin American positioned universities, years of publication, frequency, number of indicators for the evaluation, country of origin and others. In this Table it can be seen that to date webometrics is the one that covers a larger universe of universities positioned, reaching its latest edition at 12,005, of which approximately 31% belong to Latin American countries. In the rest of the Ranking, the number of Universities positioned is lower, reaching in the worst case the Shanghai Ranking where scarcely 2% belong to this region of the world. Only the Webometrics Ranking has a biannual periodicity, which allows to monitor and measure the results more frequently. Although the SIR-SCimago is one with the highest number of indicators to perform the positioning of the University, all are dedicated to the measurements of publications in the Scopus Journals, excluding measurement of academic activities. Table 6 and Fig. 1 show the variety of indicators used by each ranking to carry out the evaluation and positioning of the universities, classified among the areas of educational quality, research, innovation, presence in the community and capacity of the institution. The four have indicators that

evaluate the research products, but in most cases they exclude the innovation measured from the point of view of the patents obtained, only considered by the SIR Ranking.

Table 6 and Fig. 1 also shows the number of indicators used by each Ranking to weight the classification of the Universities. These indicators can be subclassified into those dedicated to academic, research and extension activities. In the four (4) rankings analyzed are indicators of research activity such as: number of published articles (among which the considerations between the Nature and Science journals, the Science Citation Index-Expansion and Social Science Citation Index are debated or Elsevier's Scopus database) and collaboration among academics.

Table 5. World rankings of universities, descriptive table.

	Shanghai	QS	SIR-SCimago	Webometrics
Total universities positioned worldwide	500 + 300*	959	2.966	12005
Total Latin American universities positioned	10 + 14**	385	228	3674
% Latin American Universities	2% + 4.6%	40%	8%	31%
Year of beginning of the Ranking	2003	2004	2009	2004
Years Ranking Published	2003 to 2017	2015 to 2018	2009 to 2017	2018 (January)
Year of last publication	2017	2018	2017	2018 (January)
Frequency of Publication	Annual	Annual	Annual	Bianual
Number of evaluation indicators	6	5	12	4
Country of publication	China	United Kingdom	Spain	Spain
Responsible unit	University Jiao Tong	Quacquarelli Symonds	SCimago Lab	Superior Council of Scientific Investigations
Web	http://www.shanghairanking.com	https://www.topuniversities.com	http://www.scimagoir.com	http://www.webometrics.info/es

** 500 classified universities and 300 candidates.*

*** Does not publish Latin American ranking separately.*

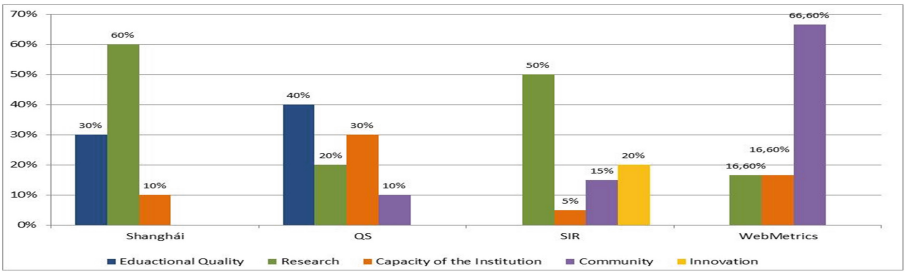

Fig. 1. Areas of evaluation of the rankings

Academic aspects include the distinctions obtained by their academics or alumni of Nobel prizes and Fields medals or the reputation measured among employers, among others. However, the extension activity is only considered by Webometrics taking among its indicators the presence, openness and excellence in the web and visibility. Finally, only the SIR Ranking considers aspects of Innovation, including patents, although Webometrics could also have it among its indicators, with the use of the Google Patents tool. It is

Table 6. Indicators and criteria of the university rankings

Area	Criteria	Rankings			
		Shanghái	QS	SIR	Webometric
Educational quality	Prestige	Alumni 10% Award 20%			
	Reputation		ACAR 40%		
Research	Citations	HiCi 20%	CIT 20%	NI 13% Exc 2%	EXC 16.6%
	Research Output	N&S 20% PUB 20%		Ewl 13% O 8% Q1 2%	
	Scientific talent			STP 5% L 5%	
	International Collaboration			IC 2%	
Innovation	Patents			IK 25% TI 5%	
Community	Incoming Link to domain web (visibility)			IL 15%	VIS 50%
	Open access				APER 16.6%
	Employer reputation		EMPR 10%		
Capacity of the institution	Professor	PCP 10%	F/STD 20%		
	International university		INT/R 10%		
	Web Size			WS 5%	PRES 16.6%

Table 7. Latin American presence in the world rankings of universities

Ranking	Shanghai (2017)		QS (2018)		SIR SCimago (2017)		Webometrics (2018-Jan)	
Country	Number of universities	%	Number of universities	%	Number of universities.	%	Number of universities	%
Argentina	1 + 2	12,5%	39	10,1%	21	9,2%	116	3,2%
Bolivia		0,0%	6	1,6%		0,0%	53	1,4%
Brazil	6 + 7	54,2%	83	21,6%	103	45,2%	1401	38,1%
Chile	2 + 2	16,7%	40	10,4%	25	11,0%	147	4,0%
Colombia	0 + 1	4,2%	53	13,8%	21	9,2%	288	7,8%
Costa Rica			6	1,6%	1	0,4%	60	1,6%
Cuba			6	1,6%	3	1,3%	27	0,7%
Ecuador			12	3,1%	6	2,6%	62	1,7%
The Savior			6	1,6%			37	1,0%
Grenada					1	0,4%	2	0,1%
Guatemala			4	1,0%			19	0,5%
Haiti							15	0,4%
Honduras			4	1,0%			16	0,4%
Jamaica					1	0,4%	22	0,6%
Mexico	1 + 1	8,3%	65	16,9%	34	14,9%	891	24,3%
Nicaragua			3	0,8%			42	1,1%
Panama			7	1,8%			25	0,7%
Paraguay			5	1,3%	1	0,4%	40	1,1%
Peru			18	4,7%	4	1,8%	182	5,0%
Puerto Rico	0 + 1	4,2%	4	1,0%	1	0,4%	37	1,0%
Dominican Republic			11	2,9%			32	0,9%
Trinidad and Tobago							9	0,2%
Uruguay			4	1,0%	1	0,4%	40	1,1%
Venezuela			9	2,3%	5	2,2%	66	1,8%
Other Caribbean Islands with 5 or less univ.							45	1,2%
Total x Ranking	10 + 14	100%	385	100%	228	100,0%	3674	100,0%

*a + b, where a corresponds to the number of classified universities, and b to the candidates.

important to highlight that the collaboration between researchers from different institutions is positively valued in the SCIR Ranking of SCimago, in the International Collaboration aspect (Institution's output produced in collaboration with foreign institutions). Additionally, only Webometrics considers the growing importance of institutional academic repositories.

Table 7 distinguish the presence of leading Latin American countries in the world rankings and with presence in the four (4) rankings studied in the present work: Brazil, Mexico, Chile, Argentina and Colombia. Special mention must be made of Puerto Rico with the presence of its universities, to a lesser extent, in said rankings. Despite the metric diversity used by the four Rankings, the Universities of Brazil always occupy the top positions in Latin America. The average presence of Latin American countries in the World Rankings Webometrics, SIR-SCimago, QS and Shanghai is: Brazil 40%, México 16%, Chile 10%, Argentina 9%, Colombia 9%, Perú 3%, Ecuador 2%, Puerto Rico 2%, Venezuela 1%, and others 8%.

5 Conclusions

The rankings used worldwide to position universities are heterogeneous and do not evaluate the teaching, research and extension activities with the same rigor and weight. However, its sustained use over time has encouraged the different universities to carry out actions that will allow them to rise in their scales. Of these, the oldest is the Shanghai Ranking that is published since 2003, followed by the QS and Webometrics that come to appear in 2004. Their indicators, with which they perform.

The evaluation and finally the positioning are not similar, nor in the form of calculation or in weight. It is noted that in the four rankings considered, the largest portion of universities positioned are not from Latin America. Going from being 40% in the QS Ranking to the worst of 2% in the Shanghai Ranking. Among the Latin American Universities with the highest participation in the four rankings are Brazil, Mexico and Argentina.

Due to the heterogeneity of the metrics it is not feasible to achieve the same positions in the classification of the Universities. In this purpose it is possible to know that each of the rankings assesses aspects that are not highly coincident with each other, despite the fact that they all aim to evaluate the quality of higher education and serve as a reference for the selection made by students at the time of start these studies. Making known their similarities and differences, based on their comparison, is the main contribution of this research work.

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