

## Comparing the Scientific Production of Peruvian Universities with Equitable Indexes

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### ARTICLE INFO

*Article history:*

*Received: 17 June, 2019*

*Accepted: 27 July, 2019*

*Online: 16 August, 2019*

*Keywords:*

*University ranking*

*SCOPUS*

*Published papers*

*Research measurement*

*Research*

### ABSTRACT

*In recent years, research has been taking an important role in Peru. There are different sources of funding for research projects, research internships, the publication of scientific articles, scholarships for postgraduate studies, among others. This importance of research has resulted in an interest in being able to measure and compare universities according to their scientific production. One of the main factors to be used to make these comparisons is the number of articles published and indexed in SCOPUS. However, this measure is not entirely fair, since it is not equitable to compare a large university with a small university since large universities have more human resources to publish scientific articles. Seeing this reality, in the present work, we present a comparison of scientific production in Peruvian universities, taking into account the size of the institutions. Among the results obtained, we can observe a change in the ranking of small universities that invest heavily in research.*

## 1. Introduction

Research is essential for the development of a country. It has already been seen during the Second World War; the main advances were made thanks to the scientists [1]. One of these advances, for example, is the development of the atomic pump thanks to the work of Albert Einstein [2].

According to what is argued by Roman-Gonzalez in [3], the research should be supported by a tripod composed of the university, the government, and the private enterprise, as shown in Figure 1.

The university is an essential support of the tripod since the university is not only called to train new professionals, but also is hoped to contribute with human knowledge, and this is achieved through research. Professors are the main actors of the investigation, but it is also the students who can collaborate in the publication of scientific articles.

The government is another significant support because it is called to define the policies and laws that promote research in a country. One of these policies that encourage research is, for example, the tax benefit for companies investing in research and technological development that currently applies in Peru [4].

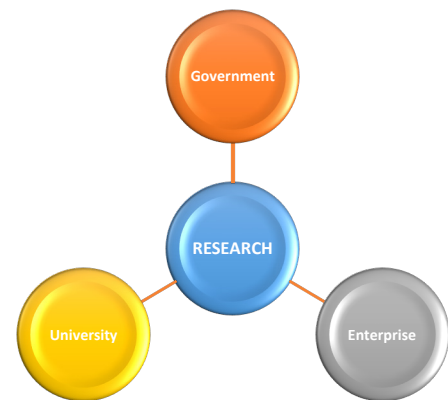


Figure 1: Tripod of the research

The private company completes the tripod since they are called to finance the research. This financing can mainly be oriented to solve problems or challenges of the same company.

In developed countries, the private sector has many challenges to solve and relies on the university (professors and students) and their capacity to face these challenges. In this way, the company finances the different research projects under a political framework established by the government.

Unfortunately, this scenario is not replicated in developing countries, mainly because companies do not trust in the

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[www.astesj.com](http://www.astesj.com)

<https://dx.doi.org/10.25046/aj0404488>

university's abilities to solve problems, and because the government does not have adequate policies to motivate the research activities.

In Peru, we are in the process of transition from one panorama (the second) to the other (the first), hoping to obtain good results.

The research is a process that follows the scientific method, and that must end in the publication of one or several scientific articles. The scientific article is nothing more than a report of the research work carried out under a pre-established format. The release of scientific articles is critical because it is necessary to let the world know about what one is researching because whatever the subject one is investigating, one is sure that on the other side of the world more research groups are working on the same subject and/or similar topics. Thanks to the publications one can get in touch with other research groups, collaborative works are achieved, joint efforts to obtain better results, scholarship opportunities, and research stay, among other benefits.

Because the research is so essential, different rankings have been established that evaluate the universities in the function of the investigation and scientific production they carry out. Among these rankings we can mention the ones elaborated by SCIMAGO [5], America Economia [6], National Superintendency of Higher University Education (SUNEDU - Superintendencia Nacional de Educacion Superior Universitaria) of Peru [7], Academic Ranking of World Universities (ARWU) [8], Webometrics [9], QS World University Ranking [10], among others. For the elaboration of these rankings, different parameters are used such as scientific production, scientific talent pool, citations by document, web size, international collaboration, domain's inbound links, percentage of publication in journals of the first quartile, average scientific quality, among others [3] [6] [11].

The universities carry out and implement different strategies to improve their position in the rankings. Some use new methodologies in their teaching processes as in [12], and others develop a whole program of formative research to get undergraduate students to start publishing scientific articles, as mentioned in [13].

One of the most critical rankings developed as a function of scientific production is the one produced by the SCIMAGO group [5] [11].

SCIMAGO generates two types of ranking, one is the SIR World, which is a worldwide ranking in which only institutions that have publications indexed in SCOPUS equal to or higher than 100 per year are included. Peru has had a growth in the number of institutions that enter in this ranking since 2009. In Figure 2, we can see this evolution where one can see that Peru went from 1 institution in 2009, passed through 4 institutions in 2012 and reached seven institutions in 2018. In Figure 2, one can also see the evolution of the best positioned Peruvian university in the ranking.

Apart from the SIR World, there is also the SIR Iber ranking that includes only Ibero-American countries. For entering into this ranking, it is only necessary to have at least one article published and indexed in SCOPUS. In Figure 3, one can see the evolution of the number of Peruvian institutions included in the SIR Iber

ranking. One can see that by 2009 there were 50 Peruvian institutions and by 2018 the number increased to 77.

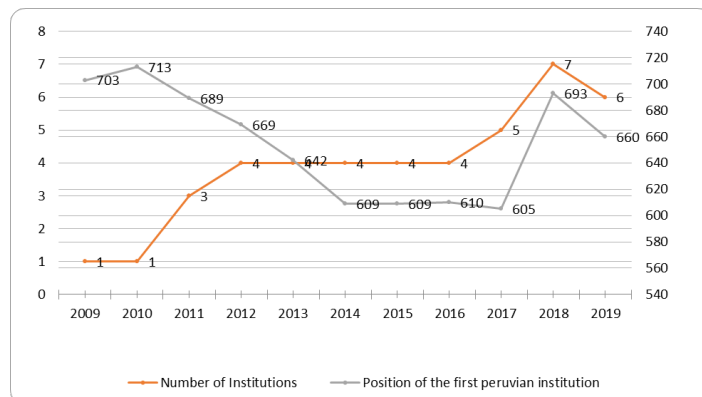


Figure 2: Evolution of the number of Peruvian institutions in the SIR World rankings [5] [11]

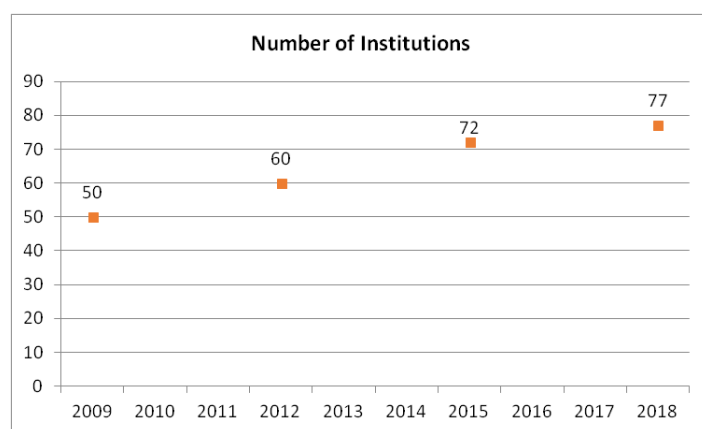


Figure 3: Evolution of the number of Peruvian institutions in the SIR Iber ranking [5] [11]

Among all the parameters mentioned above, one of the most used for the elaboration of the rankings of universities that evaluate scientific production is the number of published scientific articles. While it is true that it is an important parameter, it is not the most appropriate way to compare large universities that have many professors and students, compared to small universities with fewer professors and students. The universities with the most significant number of professors and students have more considerable human resources to carry out research and therefore, to have higher scientific production.

Faced with this situation, some proposals try to use more equitable parameters to compare scientific production in large and small universities. One of these works is the one presented in [14], where the authors use the ratio between the number of publications and the number of professors.

In this paper, one proposes other parameters that can also be used to develop rankings more equitably when comparing universities of different sizes and ages.

The continuation of this work is structured as follows: Section II shows the data source for the analysis carried out as well as the methodology followed. Section III presents the rankings obtained as a result. Finally, in Section IV, these results will be analyzed as part of the discussion and conclusions

## 2. Methodology

In Peru, due to the new University Law 30220, the majority of universities are investing more in research. Likewise, different analyzes on scientific production are being prepared, such as the one presented in [15].

The most equitable way to compare the scientific production of universities is taking into account their size. One way to include the size of the university in the elaboration of the rankings is to use the number of students. Another idea of having reference to the size of the university is to consider the amount of professor, as was done in [14].

There is a discrepancy due to the fact of considering the number of students or the number of professors since the students are not the main ones involved in the formal research process. Professors are called to do research; however, it is debatable to take into account the total number of professors or only take the number of full-time professors. It is arguably to say that just full-time professors do research.

Faced with this situation, in the present work, one takes into account the number of professors qualified as REGINA researchers. REGINA is the National Registry of Researchers by its initials in Spanish (Registro de Investigadores en Ciencia y Tecnología del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica). REGINA is a proposal of CONCYTEC (National Council of Science, Technology and Technological Innovation) that takes into account a set of parameters to evaluate the professionals who research to qualify them as researchers [16]. When considering the number of REGINA researchers per university, we will be sure to take into account those who are involved in scientific activity.

Likewise, in the present work, one will also consider the number of authors identified in SCOPUS to measure with an equitable way the scientific production in large and small universities.

In this section, the methodology followed for the elaboration of the proposed equitable rankings will be described.

### 2.1. Data Collection

The data analyzed in the present work correspond to the articles published by each university. For this, the SCOPUS database belonging to ELSEVIER will be taken as a reference. The publications of 2017, 2018 will be analyzed, and the total papers will also be taken into account.

The analysis of the present work will be carried out on all the Peruvian universities that have an ID in the SCOPUS database. According to the SUNEDU biennial report [17], in Peru, there are 142 universities of which ten did not provide services at the date of publication of the mentioned report, besides there are four graduate schools and the Facultad de Teología Pontificia y Civil de Lima that has university rank.

To access the SCOPUS data, CONCYTEC provides access to all the people registered in CTI Vitae (bio-sketches related to Science and Technology) through the credentials created for that purpose. In this sense, there will be direct access to SCOPUS, as shown in Figure 4. CTI Vitae is a database that allows people who carry out science, technology, and innovation (CTI) activities to register their resumes.

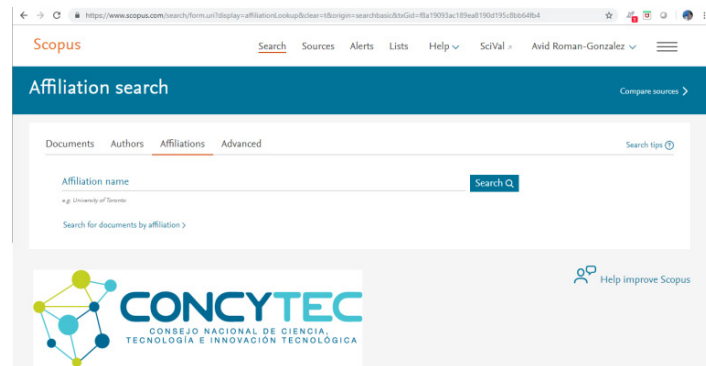


Figure 4: Access to the SCOPUS database

Likewise, the information will be collected regarding the number of professors qualified as REGINA that each university has. For this purpose, the portal created by CONCYTEC will be accessed, as shown in Figure 5



Figure 5: Access to the portal to identify the REGINA researchers for each university

All data were collected on 31st March 2019.

### 2.2. The ratio between the number of publication and number of researches and authors

For the elaboration of equitable rankings when comparing large universities with small universities, we propose to use two ratios. The first ratio will be considering the number of publications in a given year, divided by the number of REGINA researchers for each university (Equation 1). The second ratio considers the total number of publications divided by the number of authors identified in SCOPUS by each university (Equation 2).

$$R_{p/r} = P / R \quad (1)$$

$$R_{p/a} = P / A \quad (2)$$

Where:

- $R_{p/r}$  is the ratio between the number of paper indexed in SCOPUS and the number of REGINA researchers that will be used to elaborate the ranking.

- $R_{p/a}$  is the ratio between the number of paper indexed in SCOPUS and the number of authors identified in SCOPUS that will be used to elaborate the ranking.
- $P$  is the total number of published paper indexed in SCOPUS.
- $R$  is the number of REGINA researchers for each university, according to CONCYTEC.
- $A$  is the number of total authors that publish papers with the affiliation of the university under analysis, according to SCOPUS.

### 3. Results

Of all the Peruvian universities, at the date of data collection, only 66 universities have their ID in SCOPUS, have at less one publication in 2017 and 2018, and have REGINA researchers.

After the calculation of the ratios mentioned in Section II, the following results are obtained and compared with the classical ranking based only on the number of publications.

Table I and Table II show the rankings only according to the number of paper for the years 2017 and 2018, respectively.

Table 1: Ranking based on the number of papers published in 2017

N°	University	Papers SCOPUS 2017 (P)
1	Pontificia Universidad Católica del Perú	415
2	Universidad Peruana Cayetano Heredia	402
3	Universidad Nacional Mayor de San Marcos	366
4	Universidad Peruana de Ciencias Aplicadas S.A.C.	138
5	Universidad de San Martín de Porres	101
6	Universidad Nacional de San Agustín de Arequipa	76
7	Universidad Nacional Agraria La Molina	76
8	Universidad Nacional de Ingeniería	65
9	Universidad Científica del Sur S.A.C.	64
10	Universidad Nacional de San Antonio Abad del Cusco	54
11	Universidad Católica San Pablo	51
12	Universidad del Pacífico	50
13	Universidad de Piura	46
14	Universidad Privada Antenor Orrego	44
15	Universidad San Ignacio de Loyola S.A.	44
16	Universidad Nacional de Trujillo	41
17	Universidad de Ciencias y Humanidades	39
18	Universidad Privada del Norte S.A.C. -	36
19	Universidad Continental S.A.C. (*7)	36
20	Universidad ESAN	30
21	Universidad Ricardo Palma	29
22	Universidad Nacional Federico Villarreal	27
23	Universidad Nacional San Luis Gonzaga	24
24	Universidad Nacional de Piura	23
25	Universidad de Ingeniería y Tecnología	22

26	Universidad Católica de Santa María	19
27	Universidad Nacional del Altiplano	17
28	Universidad de Lima	17
29	Universidad Nacional Pedro Ruiz Gallo	14
30	Universidad Nacional de la Amazonía Peruana	13
31	Universidad Católica Los Ángeles de Chimbote (*4) -	13
32	Universidad Católica Santo Toribio de Mogrovejo -	13
33	Universidad Nacional de San Cristóbal de Huamanga	10
34	Universidad César Vallejo S.A.C.	10
35	Universidad Señor de Sipán	10
36	Universidad Nacional del Centro del Perú	9
37	Universidad Privada San Juan Bautista S.A.C. (*6)	9
38	Universidad Nacional Micaela Bastidas de Apurímac	8
39	Universidad Nacional de Tumbes	7
40	Universidad Nacional de Cajamarca	6
41	Universidad Nacional Santiago Antúnez de Mayolo	6
42	Universidad Privada de Tacna	5
43	Universidad Alas Peruanas	5
44	Universidad Privada Norbert Wiener	4
45	Universidad Católica Sedes Sapientiae	4
46	Universidad La Salle	4
47	Universidad Nacional del Callao	3
48	Universidad Nacional de Ucayali	3
49	Universidad Nacional de Huancavelica	3
50	Universidad Nacional Toribio Rodríguez de Mendoza de Amazonas	3
51	Universidad Nacional José María Arguedas	3
52	Universidad Andina Néstor Cáceres Velásquez	3
53	Universidad Andina del Cusco	3
54	Universidad Autónoma del Perú	3
55	Universidad Nacional Agraria de la Selva	2
56	Universidad Nacional Daniel Alcides Carrión	2
57	Universidad Nacional de San Martín	2
58	Universidad Nacional del Santa	2
59	Universidad Nacional Intercultural de la Amazonía	2
60	Universidad Nacional Autónoma de Chota	2
61	Universidad Peruana Los Andes	2
62	Universidad Peruana Unión	2
63	Universidad Tecnológica del Perú	2
64	Universidad Nacional Jorge Basadre Grohmann	1

Table 2: Ranking based on the number of papers published in 2018

N°	University	Papers SCOPUS 2018 (P)
1	Pontificia Universidad Católica del Perú	456
2	Universidad Nacional Mayor de San Marcos	427

3	Universidad Peruana Cayetano Heredia	411
4	Universidad Peruana de Ciencias Aplicadas S.A.C.	221
5	Universidad de San Martín de Porres	126
6	Universidad Nacional de Ingeniería	116
7	Universidad Nacional de San Agustín de Arequipa	115
8	Universidad Científica del Sur S.A.C.	101
9	Universidad de Ciencias y Humanidades	86
10	Universidad Nacional Agraria La Molina	83
11	Universidad Nacional de San Antonio Abad del Cusco	74
12	Universidad del Pacífico	66
13	Universidad San Ignacio de Loyola S.A.	63
14	Universidad Nacional de Trujillo	53
15	Universidad Continental S.A.C. (*7)	51
16	Universidad Privada del Norte S.A.C. -	47
17	Universidad de Piura	41
18	Universidad Católica San Pablo	34
19	Universidad Privada Antenor Orrego	31
20	Universidad de Ingeniería y Tecnología	31
21	Universidad Nacional Federico Villarreal	27
22	Universidad de Lima	27
23	Universidad Nacional de la Amazonía Peruana	26
24	Universidad ESAN	26
25	Universidad Nacional Pedro Ruiz Gallo	20
26	Universidad Nacional del Centro del Perú	19
27	Universidad Nacional del Altiplano	19
28	Universidad Católica de Santa María	18
29	Universidad Nacional de Piura	17
30	Universidad César Vallejo S.A.C.	17
31	Universidad La Salle	16
32	Universidad Nacional San Luis Gonzaga	14
33	Universidad Privada San Juan Bautista S.A.C. (*6)	13
34	Universidad Nacional de San Cristóbal de Huamanga	10
35	Universidad Peruana Unión	9
36	Universidad Católica Los Ángeles de Chimbote (*4) -	9
37	Universidad Alas Peruanas	9
38	Universidad Nacional Agraria de la Selva	8
39	Universidad Nacional del Santa	8
40	Universidad Nacional Santiago Antúnez de Mayolo	7
41	Universidad Nacional de Ucayali	7
42	Universidad Nacional Micaela Bastidas de Apurímac	7
43	Universidad Privada de Tacna	7
44	Universidad Nacional de Cajamarca	6
45	Universidad Nacional Toribio Rodríguez de Mendoza de Amazonas	6
46	Universidad Católica Santo Toribio de Mogrovejo -	6

47	Universidad Señor de Sipán	6
48	Universidad Nacional Jorge Basadre Grohmann	5
49	Universidad Peruana Los Andes	5
50	Universidad Autónoma del Perú	5
51	Universidad Nacional del Callao	4
52	Universidad Nacional de Huancavelica	4
53	Universidad Nacional Intercultural de la Amazonía	4
54	Universidad Ricardo Palma	4
55	Universidad Privada Norbert Wiener	4
56	Universidad Tecnológica del Perú	4
57	Universidad Nacional de San Martín	3
58	Universidad Nacional José María Arguedas	3
59	Universidad Andina Néstor Cáceres Velásquez	3
60	Universidad Andina del Cusco	3
61	Universidad Católica Sedes Sapientiae	3
62	Universidad Nacional Daniel Alcides Carrión	2
63	Universidad Nacional Autónoma de Chota	2
64	Universidad Nacional de Tumbes	1
65	Universidad Nacional Tecnológica de Lima Sur (*1)	1
66	Universidad Antonio Ruiz de Montoya	1

As indicated, these rankings are not equitable with small universities. In this sense, in Table III and Table IV, we can observe new classifications based on the  $R_{p/r}$  ratio described in Section II for the years 2017 and 2018, respectively.

Table 3: Ranking using the ratio  $R_{p/r}$  for the year 2017

Nº	University	REGINA Researchers (R)	Papers SCOPUS 2017 (P)	Paper 2017 / REGINA ( $R_{p/r}$ )
1	Universidad Nacional Federico Villarreal	1	27	27,00
2	Universidad Señor de Sipán	1	10	10,00
3	Universidad Continental S.A.C. (*7)	5	36	7,20
4	Universidad Católica Los Ángeles de Chimbote (*4) -	2	13	6,50
5	Universidad Nacional San Luis Gonzaga	4	24	6,00
6	Universidad Peruana de Ciencias Aplicadas S.A.C.	23	138	6,00
7	Universidad Privada del Norte S.A.C. -	8	36	4,50
8	Universidad Católica Santo Toribio de Mogrovejo -	3	13	4,33
9	Pontificia Universidad Católica del Perú	98	415	4,23
10	Universidad La Salle	1	4	4,00
11	Universidad Peruana Cayetano Heredia	104	402	3,87
12	Universidad Privada Antenor Orrego	12	44	3,67
13	Universidad ESAN	9	30	3,33
14	Universidad de Ciencias y Humanidades	13	39	3,00



15	Universidad Científica del Sur S.A.C.	23	64	2,78
16	Universidad de San Martín de Porres	42	101	2,40
17	Universidad Nacional de Piura	10	23	2,30
18	Universidad Ricardo Palma	13	29	2,23
19	Universidad Nacional de San Antonio Abad del Cusco	27	54	2,00
20	Universidad Nacional Daniel Alcides Carrión	1	2	2,00
21	Universidad del Pacífico	25	50	2,00
22	Universidad Católica Sedes Sapientiae	2	4	2,00
23	Universidad de Ingeniería y Tecnología	12	22	1,83
24	Universidad Nacional Pedro Ruiz Gallo	8	14	1,75
25	Universidad Nacional de San Cristóbal de Huamanga	6	10	1,67
26	Universidad Privada de Tacna	3	5	1,67
27	Universidad Católica San Pablo	32	51	1,59
28	Universidad Andina Néstor Cáceres Velásquez	2	3	1,50
29	Universidad de Piura	34	46	1,35
30	Universidad Privada San Juan Bautista S.A.C. (*6)	7	9	1,29
31	Universidad San Ignacio de Loyola S.A.	35	44	1,26
32	Universidad Nacional Mayor de San Marcos	303	366	1,21
33	Universidad Nacional de San Agustín de Arequipa	69	76	1,10
34	Universidad Nacional de Ucayali	3	3	1,00
35	Universidad Peruana Los Andes	2	2	1,00
36	Universidad Andina del Cusco	3	3	1,00
37	Universidad Privada Norbert Wiener	4	4	1,00
38	Universidad Nacional Micaela Bastidas de Apurímac	9	8	0,89
39	Universidad Nacional Agraria La Molina	88	76	0,86
40	Universidad de Lima	20	17	0,85
41	Universidad Nacional de Ingeniería	80	65	0,81
42	Universidad Nacional de Tumbes	9	7	0,78
43	Universidad Nacional Santiago Antúnez de Mayolo	8	6	0,75
44	Universidad Nacional José María Arguedas	4	3	0,75
45	Universidad Católica de Santa María	27	19	0,70
46	Universidad Nacional de Cajamarca	9	6	0,67
47	Universidad Nacional Intercultural de la Amazonía	3	2	0,67
48	Universidad Nacional Autónoma de Chota	3	2	0,67
49	Universidad Alas Peruanas	8	5	0,63
50	Universidad Nacional del Centro del Perú	15	9	0,60
51	Universidad Nacional de Huancavelica	5	3	0,60
52	Universidad Autónoma del Perú	5	3	0,60

53	Universidad Nacional de la Amazonia Peruana	22	13	0,59
54	Universidad Nacional de Trujillo	70	41	0,59
55	Universidad Nacional del Callao	6	3	0,50
56	Universidad Nacional de San Martín	5	2	0,40
57	Universidad Nacional del Altiplano	44	17	0,39
58	Universidad César Vallejo S.A.C.	29	10	0,34
59	Universidad Nacional del Santa	7	2	0,29
60	Universidad Peruana Unión	8	2	0,25
61	Universidad Tecnológica del Perú	9	2	0,22
62	Universidad Nacional Agraria de la Selva	10	2	0,20
63	Universidad Nacional Toribio Rodríguez de Mendoza de Amazonas	18	3	0,17
64	Universidad Nacional Jorge Basadre Grohmann	7	1	0,14

Table 4: Ranking using the ratio  $Rp/r$  for the year 2018

Nº	University	REGINA Researchers (R)	Papers SCOPUS 2018 (P)	Paper 2018 / REGINA (Rp/r)
1	Universidad Nacional Federico Villarreal	1	27	27,00
2	Universidad La Salle	1	16	16,00
3	Universidad Continental S.A.C. (*7)	5	51	10,20
4	Universidad Peruana de Ciencias Aplicadas S.A.C.	23	221	9,61
5	Universidad de Ciencias y Humanidades	13	86	6,62
6	Universidad Señor de Sipán	1	6	6,00
7	Universidad Privada del Norte S.A.C. -	8	47	5,88
8	Pontificia Universidad Católica del Perú	98	456	4,65
9	Universidad Católica Los Ángeles de Chimbote (*4) -	2	9	4,50
10	Universidad Científica del Sur S.A.C.	23	101	4,39
11	Universidad Peruana Cayetano Heredia	104	411	3,95
12	Universidad Nacional San Luis Gonzaga	4	14	3,50
13	Universidad de San Martín de Porres	42	126	3,00
14	Universidad ESAN	9	26	2,89
15	Universidad Nacional de San Antonio Abad del Cusco	27	74	2,74
16	Universidad del Pacífico	25	66	2,64
17	Universidad Privada Antenor Orrego	12	31	2,58
18	Universidad de Ingeniería y Tecnología	12	31	2,58
19	Universidad Nacional Pedro Ruiz Gallo	8	20	2,50
20	Universidad Peruana Los Andes	2	5	2,50
21	Universidad Nacional de Ucayali	3	7	2,33
22	Universidad Privada de Tacna	3	7	2,33

23	Universidad Nacional Daniel Alcides Carrión	1	2	2,00
24	Universidad Católica Santo Toribio de Mogrovejo -	3	6	2,00
25	Universidad Privada San Juan Bautista S.A.C. (*6)	7	13	1,86
26	Universidad San Ignacio de Loyola S.A.	35	63	1,80
27	Universidad Nacional de Piura	10	17	1,70
28	Universidad Nacional de San Cristóbal de Huamanga	6	10	1,67
29	Universidad Nacional de San Agustín de Arequipa	69	115	1,67
30	Universidad Andina Néstor Cáceres Velásquez	2	3	1,50
31	Universidad Católica Sedes Sapientiae	2	3	1,50
32	Universidad Nacional de Ingeniería	80	116	1,45
33	Universidad Nacional Mayor de San Marcos	303	427	1,41
34	Universidad de Lima	20	27	1,35
35	Universidad Nacional Intercultural de la Amazonía	3	4	1,33
36	Universidad Nacional del Centro del Perú	15	19	1,27
37	Universidad de Piura	34	41	1,21
38	Universidad Nacional de la Amazonía Peruana	22	26	1,18
39	Universidad Nacional del Santa	7	8	1,14
40	Universidad Peruana Unión	8	9	1,13
41	Universidad Alas Peruanas	8	9	1,13
42	Universidad Católica San Pablo	32	34	1,06
43	Universidad Andina del Cusco	3	3	1,00
44	Universidad Privada Norbert Wiener	4	4	1,00
45	Universidad Antonio Ruiz de Montoya	1	1	1,00
46	Universidad Autónoma del Perú	5	5	1,00
47	Universidad Nacional Agraria La Molina	88	83	0,94
48	Universidad Nacional Santiago Antúnez de Mayolo	8	7	0,88
49	Universidad Nacional Agraria de la Selva	10	8	0,80
50	Universidad Nacional de Huancavelica	5	4	0,80
51	Universidad Nacional Micaela Bastidas de Apurímac	9	7	0,78
52	Universidad Nacional de Trujillo	70	53	0,76
53	Universidad Nacional José María Arguedas	4	3	0,75
54	Universidad Nacional Jorge Basadre Grohmann	7	5	0,71
55	Universidad Nacional de Cajamarca	9	6	0,67
56	Universidad Nacional del Callao	6	4	0,67
57	Universidad Nacional Autónoma de Chota	3	2	0,67
58	Universidad Católica de Santa María	27	18	0,67
59	Universidad Nacional de San Martín	5	3	0,60

60	Universidad César Vallejo S.A.C.	29	17	0,59
61	Universidad Tecnológica del Perú	9	4	0,44
62	Universidad Nacional del Altiplano	44	19	0,43
63	Universidad Nacional Toribio Rodríguez de Mendoza de Amazonas	18	6	0,33
64	Universidad Ricardo Palma	13	4	0,31
65	Universidad Nacional Tecnológica de Lima Sur (*1)	8	1	0,13
66	Universidad Nacional de Tumbes	9	1	0,11

Likewise, in Table V, one can see the ranking developed using the  $R_{p/a}$  ratio also described in the previous section.

Table 5: Ranking using the  $R_{p/a}$  ratio

Nº	University	Papers SCOPUS (P)	Authors SCOPUS (A)	Paper / Authors ( $R_{p/a}$ )
1	Universidad Católica Los Ángeles de Chimbote (*4) -	35	10	3,50
2	Universidad Nacional Tecnológica de Lima Sur (*1)	3	1	3,00
3	Universidad Privada del Norte S.A.C. -	111	37	3,00
4	Universidad La Salle	39	13	3,00
5	Universidad Científica del Sur S.A.C.	430	154	2,79
6	Universidad San Ignacio de Loyola S.A.	181	76	2,38
7	Universidad Peruana Cayetano Heredia	4742	2088	2,27
8	Universidad Nacional José María Arguedas	9	4	2,25
9	Universidad del Pacífico	267	128	2,09
10	Universidad ESAN	200	98	2,04
11	Universidad Continental S.A.C. (*7)	116	59	1,97
12	Pontificia Universidad Católica del Perú	2899	1515	1,91
13	Universidad de Ciencias y Humanidades	170	90	1,89
14	Universidad de San Martín de Porres	558	310	1,80
15	Universidad Nacional Micaela Bastidas de Apurímac	32	18	1,78
16	Universidad Nacional Mayor de San Marcos	4378	2471	1,77
17	Universidad Andina Néstor Cáceres Velásquez	7	4	1,75
18	Universidad Antonio Ruiz de Montoya	7	4	1,75
19	Universidad Nacional Toribio Rodríguez de Mendoza de Amazonas	13	8	1,63
20	Universidad Nacional Autónoma de Chota	8	5	1,60
21	Universidad Católica San Pablo	187	121	1,55
22	Universidad Nacional de Ingeniería	687	447	1,54
23	Universidad Ricardo Palma	234	155	1,51
24	Universidad Peruana Unión	31	21	1,48
25	Universidad Nacional de Ucayali	22	15	1,47

26	Universidad Nacional de Piura	122	84	1,45
27	Universidad Nacional de la Amazonía Peruana	219	151	1,45
28	Universidad Nacional de San Antonio Abad del Cusco	523	361	1,45
29	Universidad Privada de Tacna	23	16	1,44
30	Universidad Privada Antenor Orrego	160	112	1,43
31	Universidad de Lima	125	88	1,42
32	Universidad Alas Peruanas	31	22	1,41
33	Universidad Nacional Santiago Antúnez de Mayolo	39	28	1,39
34	Universidad Nacional Agraria La Molina	641	462	1,39
35	Universidad Nacional Federico Villarreal	172	126	1,37
36	Universidad César Vallejo S.A.C.	47	35	1,34
37	Universidad Andina del Cusco	16	12	1,33
38	Universidad Católica Sedes Sapientiae	16	12	1,33
39	Universidad Nacional de Cajamarca	78	59	1,32
40	Universidad de Ingeniería y Tecnología	89	68	1,31
41	Universidad Autónoma del Perú	12	10	1,20
42	Universidad de Piura	285	239	1,19
43	Universidad Nacional Agraria de la Selva	48	41	1,17
44	Universidad Peruana Los Andes	14	12	1,17
45	Universidad Nacional Daniel Alcides Carrión	15	13	1,15
46	Universidad Privada Norbert Wiener	15	13	1,15
47	Universidad Nacional de San Martín	24	21	1,14
48	Universidad Nacional Jorge Basadre Grohmann	30	27	1,11
49	Universidad Nacional de San Agustín de Arequipa	475	429	1,11
50	Universidad Nacional San Luis Gonzaga	94	85	1,11
51	Universidad Privada San Juan Bautista S.A.C. (*6)	42	38	1,11
52	Universidad Nacional de Trujillo	364	330	1,10
53	Universidad Nacional del Altiplano	111	101	1,10
54	Universidad Nacional del Santa	20	19	1,05
55	Universidad Señor de Sipán	20	19	1,05
56	Universidad Católica de Santa María	117	113	1,04
57	Universidad Nacional Pedro Ruiz Gallo	98	95	1,03
58	Universidad Nacional Intercultural de la Amazonía	11	11	1,00
59	Universidad Tecnológica del Perú	27	27	1,00
60	Universidad Nacional de San Cristóbal de Huamanga	41	44	0,93
61	Universidad Peruana de Ciencias Aplicadas S.A.C.	875	953	0,92
62	Universidad Nacional del Centro del Perú	56	73	0,77
63	Universidad Nacional del Callao	16	21	0,76
64	Universidad Nacional de Huancavelica	34	48	0,71

65	Universidad Nacional de Tumbes	22	36	0,61
66	Universidad Católica Santo Toribio de Mogrovejo -	46	76	0,61

Through these results can be observed that small universities rise in position when we compare the results of Table I and Table II with the results of Table III and Table IV.

#### 4. Discussion and Conclusions

From Table I and Table II, it can be seen that most universities have a growth in the number of publications from 2017 to 2018. This growth is mainly due to the increasing importance that has been given to research in Peru due to many factors, among them, the new University Law, the accreditation process, and the competitive funds to finance research projects. It can be seen that the universities with the highest growth are Universidad Nacional Jorge Basadre Grohmann with 400 percent growth and Universidad Peruana Unión with 350 percent growth. Likewise, it can be seen that there are universities that show a decrease, these being the universities Universidad Ricardo Palma with 86.21 percent of regression and Universidad Nacional de Tumbes with 85.71 percent of regression. One can see in Figure 6, all publication evolution from 2017 to 2018 for the Peruvian universities.

The fact of using the number of REGINA researchers as a reference to taking into account the size of the university responds to the fact that there are opinions that indicate that not all professors carry out research, while REGINA investigators are called to carry out research. However, it is also true that some professors are not REGINA and publish scientific articles, as well as students who have publications. In that sense, the use of the number of authors identified in SCOPUS could be the best option.

In Figure 7, the distribution of the best 20 universities can be observed according to the different parameters considered in this study.

Finally, one can conclude that when one not only take into account the number of published scientific articles but also the size of the university, the ranking changes drastically resulting in great surprises, mainly in small universities that invest in research

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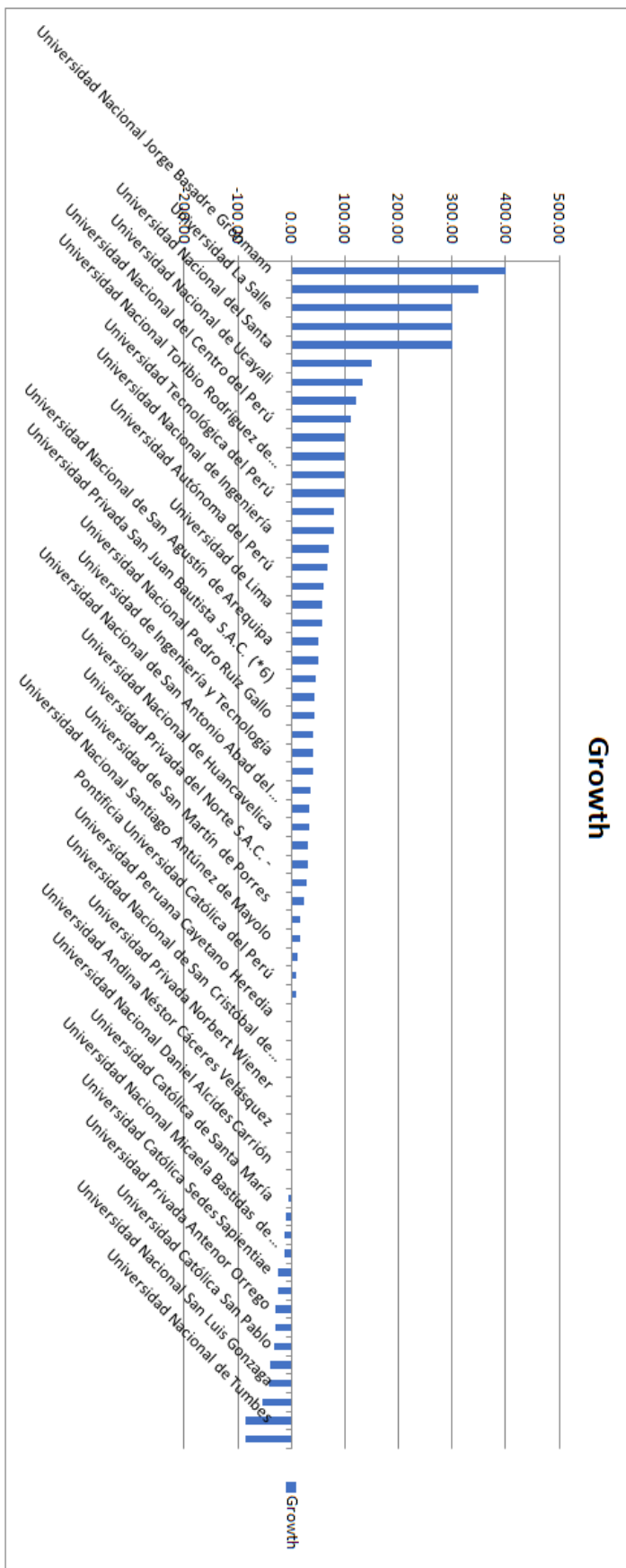


Figure 6: Distribution of the top 20 universities according to the number of publications and the ratios  $Rp/r$  and  $Rp/a$

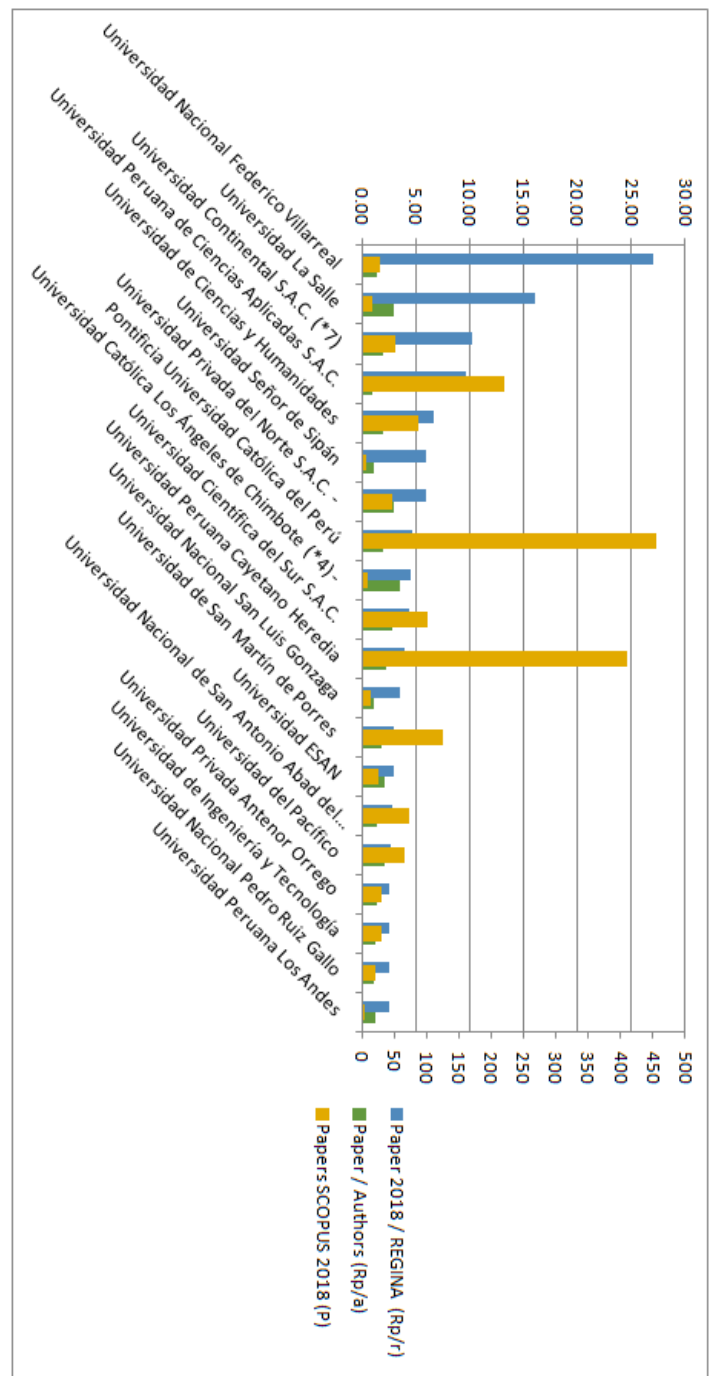


Figure 7: Distribution of the top 20 universities according to the number of publications and the ratios  $Rp/r$  and  $Rp/a$

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