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# THE EXTENT OF MULTIDISCIPLINARY AUTHORSHIP OF ARTICLES ON SCIENTOMETRICS AND BIBLIOMETRICS IN BRAZIL

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Rogério Meneghini and Abel L. Packer

## SUMMARY

The publications in scientometrics and bibliometrics with Brazilian authorship expanded exponentially in the 1990-2006 period, reaching 13 times in the Web of Science database and 19.5 times in the Google Scholar database. This increase is rather superior to that of the total Brazilian scientific production in the same time period (5.6 times in the Web of Science). Some characteristics to be noticed in this rise are: 1) The total number of articles during this period was 197; in that, 78% were published in 57 Brazilian journals and 22% in 13 international journals. 2) The national and international articles averaged 4.3 and 5.9 citations/article, respectively; two journals stood out among these, the national *Ciência da Informação* (44 articles averaging 6.7 citations/article) and the international *Scientometrics* (32 articles aver-

aging 6.2 citations/article). 3) The articles encompass an impressive participation of authors from areas other than information science; only one-fourth of the authors are bound to the information science field, the remaining ones being distributed among the areas of humanities/business administration, biology/biomedicine, health and hard sciences. The occurrence of adventitious authors at this level of multidisciplinary is uncommon in science. However, the possible benefits of such patterns are not clear in view of a fragmented intercommunication among the authors, as noticed through the citations. The advantages of changing this trend and of using other scientometric and bibliometric databases, such as *SciELO*, to avoid an almost exclusive use of the Web of Science database, are discussed.

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## Introduction

The areas of scientometrics and bibliometrics have grown significantly as regards the number of international scientific publications. Major reasons for such growth are i. a perception that citations of articles and authors bears a significant relationship with their impact and quality as compared with peer opinion (Moed, 2005); and ii. the increased use of citations in the evaluation of scientific and technological production at different levels, with significant impact on the establishment and conduction of scientific policies. This growth is a result of the involvement of researchers from many scientific fields since Eugene Garfield, a chemist, first proposed the use of citations to measure the impact of publications (Cawkell and Gar-

field, 2001). In recent years, scientometrics has been recognized as an established discipline and there are today more than twenty scientific journals that publish a considerable number of articles in the area.

In Brazil, the first articles were written thirty years ago, and attest to an interest in the use of the scientometric database of the then called Institute for Scientific Information (ISI), today known as Thomson-Reuters Scientific, as a new tool to study the development of Brazilian science (Morel and Morel, 1977a, b). Other articles with the same approach were sparsely published (Meneghini, 1983; Meis *et al.*, 1991; Dietrich, 1993) and some efforts were made towards studying sectors of the Brazilian scientific production (Velho and Krige, 1984;

Meneghini, 1992). With almost no exception, these initial articles were written by natural science researchers who saw a new opportunity to employ quantitative tools to create stimuli towards the insertion of Brazilian scientific production into the international scene. A landmark in the advance of this process was the creation by CAPES (Coordination for the Improvement of Higher Education Personnel) of incentives for the publication of articles in Web of Science-indexed journals, which eventually brought Brazil into the thirteenth position in the 2008 international ranking.

Over the last twenty years the number of articles on scientometrics and bibliometrics published by Brazilian authors increased three times as much as the world total number. This data is pre-

sented and discussed below with the aim of understanding the efforts of a growing number of researchers, their background and academic affiliation, and the potential impacts on the scientific policy in Brazil. This article will also focus on 1) the disaggregation seen in this area when the isolated context of scientific publication is considered; 2) the potential ways to overcome this situation with a procedure of integration that adds value to the work developed; and 3) the understanding, from a methodological standpoint, of the importance of using national sources of information in scientometrics and bibliometrics, such as the *SciELO* database and the curriculum directory of the Lattes Platform, since studies have so far dealt almost exclusively with international sources.

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**KEYWORDS / Bibliometrics / Citation / H Index / Infometrics / Information Science / SciELO / Scientometrics / Web of Science /**

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## EL ALCANCE DE LA AUTORÍA MULTIDISCIPLINARIA EN ARTÍCULOS SOBRE CIENTOMETRÍA Y BIBLIOMETRÍA EN BRASIL

Rogério Meneghini y Abel L. Packer

### RESUMEN

Las publicaciones en *cientometría* y *bibliometría* con autores *brasileños* crecieron exponencialmente en el período 1990-2006, alcanzando 13 veces en la base de datos del Web of Science, y 19,5 veces en la del Google Scholar. Este incremento es marcadamente mayor que el de la producción científica total en igual período (5,6 veces en el Web of Science). Algunas características destacables en ese aumento son: 1) El número total de artículos en ese período fue de 197; de ellos, 78% fueron publicados en 57 revistas *brasileñas* y 22% en 13 revistas *internacionales*. 2) Los artículos *nacionales* e *internacionales* promediaron 4,3 y 5,9 citas/artículo, respectivamente; y dos resaltaron entre ellas, la revista *nacional* *Ciência da Informação* (44 artículos con promedio de 6,7 citas/artículo) y la *internacional* *Scientometrics* (32 artículos, con promedio de 6,2 citas/artículo).

3) En los artículos se aprecia una participación impresionante de autores de áreas diferentes a las ciencias de la información; solo un cuarto de ellos está ligado a ese campo, distribuyéndose el resto en las áreas de *humanidades/administración*, *biología/biomedicina*, *salud* y *ciencias exactas*. La ocurrencia de autores a este nivel de *multidisciplinariedad* no es común en ciencias; no obstante, los posibles beneficios de tal patrón no están claros a la vista de la *intercomunicación fragmentada* entre autores, como se aprecia a través de las citas. Se discute las ventajas de cambiar esta tendencia y de usar otras bases de datos *cientométricas* y *bibliométricas*, tales como *SciELO*, para evitar el uso casi exclusivo de la del Web of Science.

## O ALCANCE DA AUTORIA MULTIDISCIPLINAR EM ARTIGOS SOBRE CIENTOMETRIA E BIBLIOMETRIA NO BRASIL

Rogério Meneghini e Abel L. Packer

### RESUMO

As publicações em *cientometria* e *bibliometria* com autores *brasileiros* cresceram exponencialmente no período de 1990-2006, alcançando 13 vezes na base de dados da Web of Science, e 19,5 vezes na da Google Scholar. Este incremento é marcadamente maior que o da produção científica total em igual período (5,6 vezes na Web of Science). Algumas características destacáveis nesse aumento são: 1) O número total de artigos nesse período foi de 197; deles, 78% foram publicados em 57 revistas *brasileiras* e 22% em 13 revistas *internacionais*. 2) Os artigos *nacionais* e *internacionais* mediarão 4,3 e 5,9 citações/artigo, respectivamente; e dois se destacaram entre elas, a revista *nacional* *Ciência da Informação* (44 artigos com médio de 6,7 citações/artigo) e a *internacional* *Scientometrics* (32 artigos, com média de 6,2 citações/artigo).

3) Nos artigos se aprecia uma participação impressionante de autores de áreas diferentes às *ciências da informação*; somente um quarto deles está ligado a esse campo, distribuindo-se o resto nas áreas de *humanidades/administração*, *biologia/biomedicina*, *saúde* e *ciências exactas*. A ocorrência de autores neste nível de *multidisciplinaridade* não é comum em *ciências*; no entanto, os possíveis benefícios de tal padrão não estão claros a vista da *intercomunicação fragmentada* entre autores, como se aprecia através das citações. Discute-se as vantagens de mudar esta tendência e de usar outras bases de dados *cientométricas* e *bibliométricas*, tais como *SciELO*, para evitar o uso quase exclusivo da Web of Science.

### Methodology

The bibliometric databases of the SciELO Brazil collection, Web of Knowledge and Google Scholar (its Brazilian version currently known as Google Acadêmico) and the Lattes Platform directory of researchers and students were used. The data were collected in August 2007. International publications were accessed at the Web of Science (WoS) database using the following search expressions both in Portuguese and English: *scientometrics*, *bibliometrics*, *infometry*, *citations*, *impact factor*, *scientific production*, *scientific policy*, *science evaluation* and *information science*. The articles were then manually sorted out to assess whether they were related to the aim of this article, a condition being that they presented quantitative indicators for science evaluation. Manual filtering was obviously more important for those articles retrieved when the search expressions were “*science evaluation*, *scientific policy* and *information science*”, where a significant percentage of the search results had no connection with the aims of this article. The articles were selected after reviewing the full text or abstracts, or, when this was not practicable, the key words

and titles were reviewed. This was feasible, since the number of articles did not exceed one thousand.

For a more comprehensive retrieval, in the case of publications by Brazilian authors, we chose to use Google Scholar and the same search expressions above, in English and Portuguese. The number number of articles found in this case was far higher than the number found in Web of Science or SciELO, since Google Scholar includes articles of national and international journals which are not indexed in the latter databases. The degree of coverage by Google Scholar of articles

indexed in WoS or SciELO was also looked at, and the average coverage was very high (>90%).

Finally, the same search expressions in Portuguese were employed to search the Lattes Platform directory of researchers, to identify Brazilian authors. In this case, journal articles were also filtered to select only those complete articles that had a connection with the object of interest, and to this end the title of the article was used.

### Results

Figure 1 shows the growth of Brazilian production on sci-

entometrics based on Google Scholar search results, with the trend curve adjusted for exponential regression using Microsoft Office Excel. For the period between 1990 and 2006 this production increased 19.5 times, and the curve shows a trend towards continued and sharp growth. The Google Scholar database was used as it was anticipated that a large number of articles that were not captured in the Web of Science and SciELO databases would be retrieved, and so it was.

Equivalent data obtained from the Web of Science database are summarized in Table I. As anticipated, it shows an impressive increase in the number of Brazilian articles in all areas in the period 1990-2006 (5.6 times), as compared with international levels (1.6 times). In the area of scientometrics and bibliometrics the increase was even sharper, 13 times for Brazil and 7.3 times for the whole world.

A more detailed study of the results of the search in the Google Scholar database (Table II) reveals interesting aspects concerning the production by Brazilian authors: (i) the large number of journals used (70), the vast majority being Brazilian journals (81.4%); (ii) the significant number of articles (197, that is, the cumulative number of articles in Figure 1) published mostly in Brazilian journals (77.7%); and (iii) the number of citations per article in Brazilian journals, which is close to that of international journals (4.31 vs 5.95).

Table III shows the journals that published three or more articles in the field. There are 18 Brazilian journals and only two international ones (*Scientometrics* and *Archiv*). The number of articles published and the average citations per

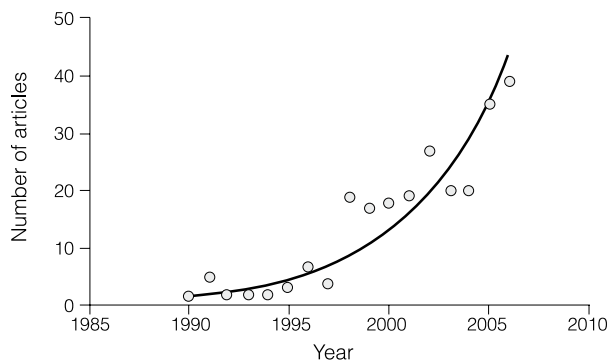


Figure 1. Growth of Brazilian production on scientometrics (from Google Scholar database).

article received by *Ciência da Informação* (44 and 6.7, respectively) are expressive, and both figures are above those of *Scientometrics* (32

these articles was written by the authors with a view to assess their field or institution of interest as concerns scientific performance, and these authors were influenced by the fact that it is very easy to obtain data, since the most widely used database, the Thomsom-Reuters Scientific database, has been available for some time now from the CAPES Portal of Journals. Only 25% of the authors are from the information scienc-

de Minas Gerais (UFMG; 16), Universidade Estadual de Campinas (UNICAMP; 14), Universidade Federal de São Carlos (UFSCAR; 12), Universidade Federal do Rio Grande do Sul (UFRGS; 10) and Fundação Oswaldo Cruz (FIOCRUZ; 10). It is worth highlighting that authors who frequently publish articles in collaboration are concentrated in a few centers, such as the Department of Scientific and Technology Policy of the Institute of Earth Sciences of UNICAMP (10 articles), the Department of Information Sciences of UFSCAR (10), the Institute of Medical Biochemistry of UFRJ (8) and the School of Information Science

of UFMG (8). These centers offer post-graduate courses in information science and gather a substantial number of authors.

Almost all the authors had obtained a doctoral degree; 60 of them had obtained it at USP, 29 at UFRJ, and 12 in other Brazilian institutions. Since the Ph.D. degrees are from multiple areas of knowledge, it is significant that the two mentioned universities have been able to train such a large number of post-graduate students. It is also noteworthy that 80 of the 237 authors carried out their post-doctoral training in different areas, and 66 of them in foreign institutions.

## Discussion

The number of publications in the area of scientometrics and bibliometrics is increasing at a faster pace than in all other areas of science, both in Brazil and worldwide. In Brazil, the number of publications increased 13 times and 19.5 times in the Web of Science and Google Scholar databases, respectively, in the period 1990-2006 (Table I).

TABLE I  
INCREASE IN THE NUMBER OF ARTICLES PUBLISHED IN 1990-2006 IN ALL AREAS AND ON SCIENTOMETRICS AND BIBLIOMETRICS, IN THE WORLD AND IN BRAZIL

Area of articles	Increase in the number of articles	Database
Articles in all areas worldwide	1.6	Web of Science
Articles in all areas in Brazil	5.6	Web of Science
Articles on scientometrics worldwide	7.3	Web of Science
Articles on scientometrics in Brazil	13	Web of Science
Articles on scientometrics in Brazil	19.5	Google Scholar

and 6.2). Also expressive are the average citations per article of the Brazilian journals *Brazilian Journal of Medical and Biological Research* and *Revista de Saúde Pública*.

Many Brazilian researchers from different fields of knowledge have published articles using quantitative indicators of scientific publications, scientific policies and science evaluation. Table IV shows the results of a search for authors of articles as returned by the Google Scholar database and Lattes Platform curriculum directory, a total of 237 authors. A substantial part of

es area, most of them being scholars in the areas of humanities/business administration, biology/biomedicine, health, and hard sciences. Bibliographic reference lists (not shown) reveal little interaction among authors from different fields.

The 237 authors retrieved were affiliated with 50 large Brazilian institutions of which seven stand out in view of the number of articles. These are Universidade de São Paulo (USP; 35 articles), Universidade Federal do Rio de Janeiro (UFRJ; 23), Universidade Federal

TABLE II  
JOURNALS, CITATIONS AND ARTICLES PUBLISHED BY BRAZILIAN AUTHORS IN 1990-2006 ON SCIENTOMETRICS AND BIBLIOMETRICS, USING THE GOOGLE SCHOLAR DATABASE

	Number of journals	Number of citations	Number of articles	Citations per article
Brazilian	57 (81.4%)	660	153 (77.7%)	4.31
International	13 (18.6%)	262	44 (22.3%)	5.95
Total	70	922	197	4.68

Other studies have been conducted on this topic. For instance, Parreiras *et al.* (2006) studied Brazilian publications on information sciences and focused on collaboration networks. The large number of authors found (1309) as compared with this article (237) is due to the fact that in their study the identification of articles on information science was not restricted to quantitative articles on scientometrics and bibliometrics, but rather covered a more diversified set of topics. Additionally, their study included papers presented in conferences. If on the one hand their study was comprehensive in the context of information science, on the other hand it was restricted to four journals of the area (*Ciência da Informação*, *Perspectiva em Ciência da Informação*, *Informação e Sociedade* and *Datagrama-zero*) and to a few area-specific conferences. Within the scope of the present survey we also identified authors from other major fields of knowledge who conducted scientometric and bibliometric studies, frequently focusing on the performance of their areas or research institutions. In fact, in the context of scientometrics and bibliometrics the number of adventitious authors, whose primary area of study and publication was not information sciences, greatly surpasses the number of information science researchers (Table IV). Likewise, there was a larger number of articles published in Brazilian journals that specialize

TABLE III  
MOST USED JOURNALS, WITH THREE OR MORE ARTICLES PUBLISHED, TOTAL CITATIONS AND CITATIONS PER ARTICLE \*

Most used journals	Number of articles	Number of citations	Citations/Article
<i>Ciência da Informação</i> (SciELO)	44	295	6.7
<i>Scientometrics</i> (JCR)	32	197	6.2
<i>Brazilian Journal of Medical and Biological Research</i> (SciELO, JCR)	8	68	8.5
<i>São Paulo em Perspectiva</i> (SciELO)	7	19	2.7
<i>Revista de Saúde Pública</i> (SciELO, JCR)	6	42	7
<i>Caderno de Ciência e Tecnologia</i>	5	1	0.2
<i>Caderno de Saúde Pública</i> (SciELO)	5	17	3.4
<i>Química Nova</i> (SciELO, JCR)	5	26	5.2
<i>Acta Cirúrgica Brasileira</i> (SciELO)	4	4	1
<i>Perspectiva de Ciência da Informação</i> (SciELO)	4	4	1
<i>Revista Brasileira de Psiquiatria</i> (SciELO)	4	10	2.5
<i>Archiv</i>	3	4	1.3
<i>Caderno Pagu</i> (SciELO)	3	3	1
<i>Ciência e Cultura</i>	3	6	2
<i>Ciência e Saúde Coletiva</i> (SciELO)	3	5	1.7
<i>Dados</i> (SciELO)	3	1	0.3
<i>Estudos Avançados</i> (SciELO)	3	14	4.7
<i>História de Cien Saúde Manguinhos</i> (SciELO)	3	12	6
<i>Jornal de Pediatria</i> (SciELO)	3	5	1.7
<i>Revista Latino-Americana de Enfermagem</i> (SciELO)	3	16	5.3

\* From the Google Acadêmico database. The indexation of the journals in the SciELO and JCR (Journal Citation Report) are indicated in parenthesis.

in areas other than information science.

Other studies on the production of articles on information sciences have been published recently, but these studies focused specifically on bibliometrics and on journals of the information area (Machado, 2007), or on performing a thematic analysis of the articles of this area of knowledge (Bufrem *et al.*, 2007). Mugnaini (2006) also noted the adventitious nature of researchers from other areas who venture into scientometrics.

The interest of researchers from multiple areas in scientometrics and bibliometrics is remarkable. On the one hand, this has to do with the development of the Internet and the availability of pub-

lications and statistical data in databases such as WoS, Google Scholar and SciELO, in addition to the ease of handling such data, which is appealing to learners. On the other hand, there are practices in place for evaluating academic and scientific production that recognize the pertinence of scientometrics and bibliometrics, among other methods, to inform the management of science, technology and innovation. It is not by chance that a strong interest in academic and scientific policy has been motivating researchers from the area of natural sciences, who are keener on numbers, to venture into scientometrics. Although its methodological approach has become a discipline on its

TABLE IV  
BREAKDOWN PER AREA OF KNOWLEDGE OF THE 237 AUTHORS OF ARTICLES IN THE AREA OF SCIENTOMETRICS AND BIBLIOMETRICS IDENTIFIED IN THE LATTES PLATFORM AND GOOGLE SCHOLAR

Information sciences	Humanities / administration	Biological / biomedical sciences	Health sciences	Hard sciences
63	62	37	46	29

own, mastered by specialists (Moed, 2005), researchers from the natural sciences have made important contributions towards creating relevant indicators, as was the case with the h index, proposed by a superconductivity physicist (Hirsch, 2005).

It is remarkable that there are so many articles in the literature that describe the importance of scientometrics and bibliometrics for studying the multidisciplinary and interdisciplinarity of science and technology, but it is very hard to find articles focusing on the multidisciplinary interest on scientometrics. This interest, as has

been observed, is strong in Brazil, and more so than in the United States, for example. In a preliminary survey of North-American articles for the period 2003-2007 in the periodical *Scientometrics*, 72 original articles were found, of which 56 were written by authors from the area of information sciences. This attests to a greater specialization in scientometrics and bibliometrics in the United States than in Brazil. However, the multidisciplinary background of researchers in scientometrics is an unusual characteristic in the sciences at large, and it might not have been explored in studies on information sciences, where Brazil has been studied as a case because of the prevailing trend towards publishing articles in collaboration with other fields of knowledge (Leta *et al.*, 2006). It could be that if more intense interaction was fostered be-

tween those researchers who publish articles on scientometrics and bibliometrics, new and interesting lines of thought and investigation would come up.

Additionally, there is a new source of information for Ibero American countries and especially Brazil, the SciELO scientometrics and bibliometrics database, which focuses on the Brazilian and regional production of quality scientific knowledge and information. This database can be further explored in studies on communication with a view to establishing new concepts for scientific policies (Meneghini *et al.*, 2006; Meneghini and Packer, 2007; Packer and Meneghini, 2007). Brazilian authors of articles on scientometrics tend to direct their attention almost exclusively to Thomson-Reuters products. It is worth noting that the SciELO database in Brazil includes approximately 200 journals, 146000 articles and 3.2 million citations. It has tools in place to allow bibliometric surveys with ease of access and handling in a

universe of publications that is not usually explored by scientometric studies.

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