

The Extent of Multidisciplinary Authorship of Articles on Scientometrics and Bibliometrics in Brazil

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Abstract

The publications in scientometrics 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. 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* and the international *Scientometrics*; (3) the articles encompass an impressive participation of authors from areas other than information science. The occurrence of adventitious authors at this level of multidisciplinary is uncommon in science. However, the possible benefits of such pattern are not clear in view of a fragmented intercommunication among the authors, as noticed by the citations. The advantages of improving the intercommunicability among authors 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.

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; GARFIELD, 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 attested to an interest in the use of the scientometric database of the then called Institute for Scientific Information (ISI), today known as Thomson-Reuteurs Scientific, as a new tool to study the development of Brazilian science (MOREL; MOREL, 1977a, 1977b). Other articles with the same approach were sparsely published (DIETRICH, 1993; MEIS; MACHADO; LESSA; RUMJANEK, 1991; MENEGHINI, 1983) and some efforts were made towards studying sectors of the Brazilian scientific production (MENEGHINI, 1992; VELHO; KRIGE, 1984). With almost no exception, these first 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 of the advance of this process was the creation by CAPES (Coordination for the Improvement Higher Education Personnel) of incentives for the publication of articles in Web of Science-indexed journals, which eventually took Brazil to the fifteenth position in the 2006 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 presented and discussed below with the objective 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: (i) the poor intercommunicability among the authors in this area when the isolated context of scientific publications is considered; (ii) the potential ways to overcome this situation with a procedure of integration that adds value to the work developed; and (III) finally, from a methodological standpoint, understanding 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.

Methodology

We used the bibliometric databases of the SciELO Brazil collection, Web of Knowledge and Google Scholar and the Lattes Platform directory of researchers and students. The data were collected in August 2007. International publications were accessed at the Web of Science (WoS) database, using the following search expressions in English and Portuguese: scientometrics, bibliometrics, infometrics, 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 object 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 objective of this article. The articles were selected after reviewing the full text or abstracts, or, when this was not practicable, we reviewed the key words and titles, whatever 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, both in English and Portuguese. The 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. We also compared Google Scholar’s degree of coverage of articles indexed in WoS or SciELO, and the average coverage was very high (> 90%).

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

Results

Figure 1 shows the growth of Brazilian production on scientometrics 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. We used the Google Scholar database as we 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.

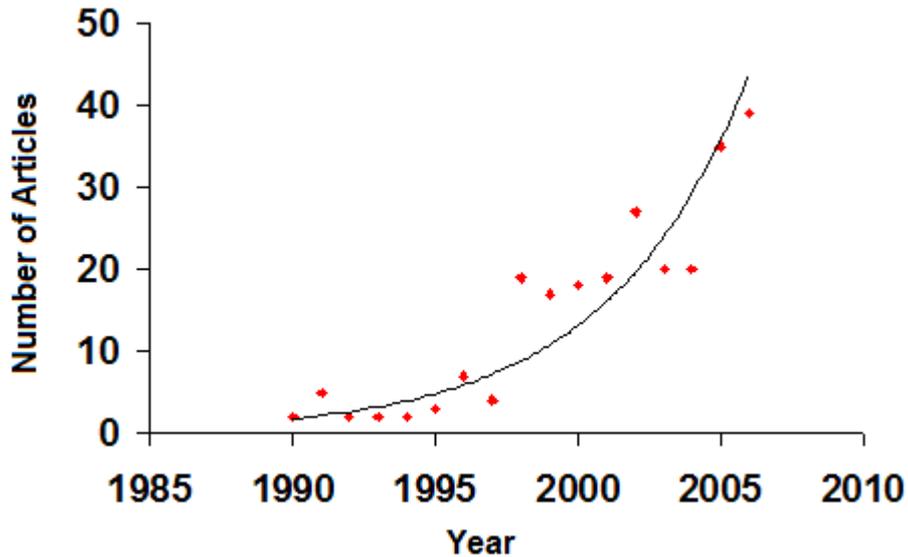


Figure 1. Growth of Brazilian production on scientometrics (Google Scholar database).

Equivalent data obtained from the Web of Science database are summarized in Table I. As we anticipated, it shows 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.

Table 1 – Increase in the number of articles published in the period 1990-2006 in all areas and in scientometrics and bibliometrics, in the world and in Brazil

Area of articles	Column 1	Column 2
	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
Source: Survey by the authors		

A more detailed study of the results of the search in the Google Scholar database shows interesting aspects concerning the production of Brazilian authors (Table 2): (i) the large number of journals used (70), in that the vast majority was Brazilian (81.4%); (ii) the significant number of articles (197, that is, the sum of the articles of Figure 1) published mostly in Brazilian journals (77.7%); (iii) the number of citations per article in Brazilian journals is approximately the same as in international journals (4.31 versus 5.95).

Table 2 - Journals, citations and articles published by Brazilian authors in the period 1990-2006 on scientometrics and bibliometrics, using the Google Scholar database

	Column 1	Column 2	Column 3	Column 4
	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
Source: Survey by the authors				

Table 3 shows the journals that published three or more articles in the field. There are 18 Brazilian journals and only two international (Scientometrics and Archiv). The number of articles published and the average citations per article received by *Ciência da Informação* (44 and 6.7, respectively) are expressive and both figures are above those of *Scientometrics* (32 and 6.2, respectively). 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 on scientific publications, scientific policies and science evaluation. Table 4 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 these articles was written by the authors with a view to assessing 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-Reuteurs Scientific database, has been available for some time now from the Capes Portal of Journals. We observed that only 25% of the authors are from the information sciences area, and most are scholars of the following areas: humanities/business administration, biology/biomedicine, health and hard sciences. Bibliographic reference lists (not shown) show 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: Universidade de São Paulo (USP) (35 articles), Universidade Federal do Rio de Janeiro (UFRJ) (23), Universidade Federal 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: Department of Scientific and Technology Policy of the Institute of Earth Sciences of UNICAMP (10 articles), Department of Information Sciences of UFSCAR (10), 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.

Table 3 – Most used journals, with three or more articles published, total citations and citations per article (Google Acadêmico database)

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

The indexation of the journals in the SciELO and JCR (Journal Citation Report) are indicated in parenthesis.

Source: Survey by the authors

Table 4 – Breakdown per area of knowledge of the 237 authors of articles in the area of scientometrics and bibliometrics identified in the Lattes Platform

Column 1	Column 2	Column 3	Column 4	Column 5
Information Sciences	Humanities/ administration	Biological/biomedical sciences	Health sciences	Hard sciences
63	62	37	46	29

Source: Survey by the authors

Almost all the authors had obtained a PhD: 60 of them had obtained it at USP, 29 at UFRJ, and 12 in other Brazilian institutions. Since the PhD degrees are from multiple areas of knowledge, it is significant that these two universities have been able to train such a large number of post-graduate students. It is also noteworthy that 80 of the 237 authors did their post-doctoral studies in different areas, of which 66 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 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 1).

Other studies have been conducted about 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 the case of 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 articles 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 *Datagramazero*) and to a few area-specific conferences. Within the scope of our 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, has greatly surpassed the number of information science researchers (Table 4). Likewise, there was a larger number of articles published in Brazilian journals that specialize 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; SILVA; RAMOS; FABIAN; SORRIBAS, 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 publications 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 which recognize the pertinence of scientometrics and bibliometrics, among other methods, to inform the management of science, technology and innovation. Not by chance, 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 own which is 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 which 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 stronger here 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 scientometrics researchers 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; GLANZEL; THIJS, 2006). It could be that if more intense interaction was fostered between those researchers who publish articles on scientometrics and bibliometrics, new and interesting lines of thought and investigation would come up. Within this context, we highlight the timeliness of a regional and an international congress on scientometrics, to be held in Rio de Janeiro in September 2008 (<http://www.crics8.org>) and July 2009 (<http://www.issi2009.org>), respectively.

Additionally, there is a new source of information for Iberoamerican countries and especially Brazil: the SciELO scientometrics and bibliometrics database that 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 (MENEHINI; MUGNAINI; PACKER, 2006; MENEHINI; PACKER, 2007; PACKER; MENEHINI, 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, 100,000 articles and two million citations. It has tools in place to allow bibliometric surveys with ease of access and handling in a universe of publications which is not usually explored by scientometric studies.

References

- BUFREM, L. S.; SILVA, H. F. N.; RAMOS, C. L. S.; FABIAN, M.; SORRIBAS, T. V. Produção científica em ciência da informação: análise temática em artigos de revistas brasileiras. *Perspectivas em Ciência da Informação*, v.12, p.38-49, 2007.
- CAWKELL, A. E.; GARFIELD E. Institute for Scientific Information-chapter published in "A Century of Science Publishing: A collection of essays. Ed. E.H. Fredriksson, IOS Press, 200, p.149-160, 2001.
- DIETRICH, C. P. The Garfield apprentices. *Ciência e Cultura, Brasil*, v.45, p.11-12, 1993.
- HIRSCH, J. E. An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences*, v.102, p.16569-16572, 2005.
- LETA, J.; GLANZEL, W.; THIJS, B. Science in Brazil. Part 2: sectoral and institutional research profiles. *Scientometrics*, v.67, p.87-105, 2006.
- MACHADO, R. N. Análise cientométrica dos estudos bibliométricos em periódicos da área de biblioteconomia e ciência da informação (1990-2005). *Perspectivas em Ciência da Informação*, v.12, p.2-20, 2007.
- MEIS, L.; LONGO, P. H. The training of Brazilian biochemists in Brazil and in developed countries: costs and benefits. *Biochemical Education*, v.18, p.182-188, 1990.
- MEIS, L.; MACHADO, R. C.; LESSA, F.; RUMJANEK, V. M. Science And Industry In Developed And Developing Countries. *Ciência e Cultura, Brasil*, v.43, p.278-281, 1991.
- MENEHINI, R. Brazilian production In biochemistry. The question of international versus domestic production. *Scientometrics*, v.23, p.21-30, 1992.
- MENEHINI, R. O descompasso entre produção científica e econômica no Brasil. *Folha de São Paulo*. São Paulo, p.19, 03 dez. 1983.
- MENEHINI, R.; MUGNAINI, R.; PACKER, A. L. International versus national oriented Brazilian scientific journals. A scientometric analysis based on SciELO and JCR-ISI databases. *Scientometrics*, v.69, p.529-538, 2006.
- MENEHINI, R.; PACKER, A. L. Is there Science beyond English? *EMBO Reports*, v.8, p.112-116, 2007.
- MOED, H. F. *Citation analysis in research evaluation*. Springer, 2005.
- MOREL, R. L. M.; MOREL, C. M. Um estudo sobre a produção científica brasileira segundo os dados do Institute for Scientific Information (ISI). II- O banco de dados ISI/Asca/Brasil, um novo instrumento para a análise da ciência brasileira. *Ciência da Informação*, v.7, p.79-83, 1977.

- MOREL, R. L. M.; MOREL, C. M. Um estudo sobre a Produção científica brasileira segundo os dados do Institute for Scientific Information (ISI). *Ciência da Informação*, v.6, p.99-109, 1977.
- MUGNAINI, R. Caminhos para adequação da avaliação da produção científica brasileira: impacto nacional versus internacional. Tese Doutorado. Universidade de São Paulo, 2006.
- PACKER, A. L.; MENEGHINI R. Learning to communicate science in developing countries. *Interciencia* (Caracas), v.32, p.643-647, 2007.
- PARREIRAS, F. S.; OLIVEIRA SILVA, A. B.; MATHEUS R. F.; W. C. BRANDÃO. REDECI: colaboração e produção científica em ciência da informação no Brasil . *Perspectivas em Ciência da Informação*. v.11, p.302-317, 2006.
- VELHO, L.; KRIGE, J. Publication and citation practices of Brazilian agricultural scientists. *Social Studies of Science*, v.14, p.45-62, 1984.