
LEARNING TO COMMUNICATE SCIENCE IN DEVELOPING COUNTRIES

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SUMMARY

Good quality science has been produced in developing countries, as shown by the number of papers published in prestigious journals. However, the competence to produce good journals in these countries has lagged behind for several reasons, particularly the establishment of an international publishing system relying on the increasing value attributed to the ISI-JCR journal ranking, a view adopted by authors worldwide and by funding and evaluation systems. Developing countries became integrated to this international context and the efforts to produce good local journals can be pinpointed to individual initiatives that in most cases failed to progress. One important consequence of this gap is that dealing with the peer review procedure, a major instrument to produce good journals and to foster scientific progress, is a limited experience in developing countries. Un-

der this scenery an enterprise that began in Brazil in 1997 and thereafter spread over twelve other Iberoamerican countries is discussed in the light of recent data. SciELO (Scientific Electronic Library Online) is a program fundamentally supported by public funding, aimed at launching online the best existing journals in several countries, in an open access mode, based on peer-reviewing and bibliometric/scientometric analysis for the purpose of journal indexation and maintenance in its database. SciELO covers the functions of a meta-publisher and aims to operate in accordance with the open access movement, rendering scientific knowledge more widely available. The data presented show encouraging evidences that a new auspicious panorama is being established in the context of producing scientific journals in Brazil.

APRENDIENDO A COMUNICAR CIENCIA EN PAÍSES EN DESARROLLO

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RESUMEN

En países en desarrollo se ha producido ciencia de buena calidad, como lo demuestra el número de trabajos publicados en revistas prestigiosas. Sin embargo, la capacidad de producir buenas revistas en tales países está en rémora por varias razones, particularmente la existencia de un sistema internacional de publicaciones dependiente del creciente valor atribuido a la clasificación del ISI-JCR, un enfoque adoptado por autores en todo el mundo, y por sistemas de financiamiento y evaluación. Los países en desarrollo se integraron a este contexto internacional y los esfuerzos por producir buenas revistas locales se limitan a iniciativas puntuales que casi nunca progresan. Una consecuencia importante de este déficit se refiere a la evaluación por pares, instrumento importante para la producción de buenas revistas y fomentar el progreso de la ciencia, que es una

experiencia limitada en países en desarrollo. En ese escenario se discute, a la luz de datos recientes, una experiencia iniciada en Brasil y luego adoptada en doce países iberoamericanos. SciELO (Scientific Electronic Library Online) es un programa fundamentalmente apoyado por fondos públicos, dirigido al lanzamiento en línea de las mejores revistas de varios países, con acceso abierto, basadas en revisión por pares y con análisis bibliométrico/cientométrico a fin de indexarlas y mantenerlas en la base de datos. SciELO hace las funciones de un meta-editorial y aspira operar según el movimiento de acceso abierto, haciendo más disponible al conocimiento científico. Los datos presentados muestran evidencias auspiciosas de que un nuevo panorama está siendo establecido en el contexto de la producción de revistas científicas en Brasil.

Introduction

Most of the steps necessary to make good science have been taken in several developing countries, as shown by the evolution of the number of papers published in prestigious international journals along the years. In Brazil, human resources in science

have increased significantly from the 70's to the present, mainly due to a well conducted program of post-graduation studies, the accessibility to fellowships for post-doctoral tenures in the country and abroad, and intense collaborative activities with other countries (Guimarães *et al.*, 1995; Meneghini, 1996; Leta *et al.*,

1998; Leta and Chaimovich, 2002). The funding for grants and infra-structure investments has duplicated, in USD, in the period 1994-2003 and the scientific production responded to this input (Leta *et al.*, 2006). Also, in recent years, there has been a major increase in the availability of online scientific information, fostered

by the electronic publishing in the web.

However, when it comes to producing good scientific journals, the results in Brazil and in other developing countries have hardly matched those improvements. This can be perceived by the significant under-representation of journals from developing countries in

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RESUMO

Países em desenvolvimento têm produzido ciência de boa qualidade, como demonstrado pelo número de trabalhos publicados em revistas prestigiosas. No entanto, a capacidade de produzir boas revistas em tais países está obstaculizada por várias razões, particularmente a existência de um sistema internacional de publicações dependente do crescente valor atribuído à classificação do ISI-JCR, um enfoque adotado por autores em todo o mundo, e por sistemas de financiamento e avaliação. Os países em desenvolvimento se integraram a este contexto internacional e os esforços por produzir boas revistas locais se limitam a iniciativas pontuais que quase nunca progredem. Uma conseqüência importante de este déficit se refere à avaliação por pares, instrumento importante para a produção de boas revistas e para fomentar o progresso da ciência,

que é uma experiência limitada em países em desenvolvimento. Nesse cenário é discutida, à luz de dados recentes, uma experiência iniciada no Brasil e logo adotada em doze países ibero-americanos. SciELO (Scientific Electronic Library Online) é um programa fundamentalmente apoiado por fundos públicos, dirigido ao lançamento em linha das melhores revistas de vários países, com acesso aberto, baseadas em revisão por pares e com análise bibliométrico/cientométrico a fim de indexá-las e mantê-las na base de dados. SciELO faz as funções de uma meta-editorial e aspira operar segundo o movimento de acesso aberto, fazendo mais disponível ao conhecimento científico. Os dados apresentados mostram evidências auspiciosas de que um novo panorama está sendo estabelecido no contexto da produção de revistas científicas no Brasil.

the international bibliographic indexes, particularly in the Thomson ISI Journal Citation Report (JCR) database. Although many questions may be raised regarding as to how adequate and straightforward is the measurement of quality of a journal through this indexation, it is doubtless that the JCR database encompasses the core of the most prestigious journals worldwide in the many different areas.

Data Sources, Processing and Results

The simple number of JCR indexed journals from a given country does not provide an adequate figure of the relative representation of this country in the database. But, if this number is normalized to the production of articles of such country in the ISI Web of Science (WoS) database a better indicator of its expressiveness is accomplished. In Table I the relative number of journals and articles from six developed countries indexed respectively in the JCR and WoS in 2004 were compared with those from six selected developing countries. The ratio between the relative number of journals in the JCR Science Edition and relative number of articles in WoS (column B/D) is 6.3 times higher for the developed countries. This ratio gives a measurement of how an inter-

national mainstream database appraises the journals of these two groups of countries.

In addition, the journals from developing countries that

were indexed in JCR are mostly in the fourth quartile of the impact factor (IF) distribution in their thematic area. The IF in a given year is a measurement of the average number of

citations per article a journal received in the past two years. Table II shows the evolution of the IF distribution of the Latin American and Caribbean journals indexed in the JCR from

TABLE I
REPRESENTATION OF SOME COUNTRY JOURNALS IN THE JCR DATABASE

Country	A ISI journals*	B % total	C ISI publications**	D % total	B/D	Average B/D
Developed						
Netherlands	571	9.58	21346	2.02	4.74	
England	1235	20.69	65880	6.22	3.33	
USA	2288	38.33	313625	29.61	1.29	
Germany	427	7.16	69808	6.59	1.09	
France	143	2.40	47955	4.53	0.52	
Australia	60	1.01	23746	2.24	0.45	1.90
Developing						
Chile	8	0.13	2419	0.23	0.57	
India	47	0.79	20299	1.92	0.41	
China	71	1.19	51219	4.84	0.25	
Brazil	16	0.27	14502	1.37	0.20	
Argentina	5	0.08	4516	0.43	0.19	
Mexico	7	0.12	7659	0.72	0.17	0.30

* ISI JCR 2004 Science Edition

** WoS, year 2004.

TABLE II
NUMBER OF LATIN AMERICAN AND CARIBBEAN JOURNALS IN THE FOUR IMPACT FACTOR QUANTILES OF JCR*

Year												Total	
1998		1999		2000		2001		2002		2003		Total	
n	%	n	%	n	%	n	%	n	%	n	%	n	%
0	0	0	0	0	0	2	4	1	2	0	0	3	1
3	7	2	4	0	0	1	2	5	9	6	11	17	6
10	22	6	13	13	26	9	17	10	19	9	16	57	19
33	72	40	83	37	74	40	77	38	70	40	73	228	75
46	100	48	100	50	100	52	100	54	100	55	100	305	100

* Quartiles 1 to 4 from top to bottom.

1998 to 2003, considering the category where they have the highest IF, as the same journal can be in different quartiles when it is classified in more than one JCR category (sub-field) of science. About 75% of the journals are located in the fourth quartile and remained in this position over that period of time. During the same period the production of articles indexed by WoS by these countries increased by 50% (<http://scientific.thomson.com>).

It is certainly a matter of concern to know why the developing countries (and in this respect some developed countries as well) have not kept pace in producing good scientific journals as compared to doing good science. Certainly, the ability to communicate in the lingua franca plays a role (with the exception of India in the example of Table I), and demands towards the authors to produce well-written English texts have become tougher (Meneghini and Packer, 2007). But, this does not seem to provide a full answer.

Another and probably the most important factor has been the worldwide compliance of scientists to follow the scientific publication system developed after the Second World War, when publishers came to manage and operate all the production procedures for most of the scientific journals, from peer-reviewing to distribution of the final edited issue. In this respect, an interesting and not intended symbiosis has grown between publishers and JCR, since the IF permitted to establish a pyramid of journals prestige. The publishers, in turn, established strategies pursuing better IF for their journals. At the same time, decision making in research funding agencies and evaluation systems became increasingly dependent on publications in journals with high IF. The effort of the authors to publish in high IF journals was inevitable, since this influenced in his/her carrier progress, personal prestige and the chances of receiving funding for research. Therefore, a reso-

nant interaction among authors, JCR, and commercial and scientific society publishers was established (PLoS, 2006).

Although the Internet impelled the launching of the open access (OA) movement with expectations of changing the scenario of scientific publication, the business publisher system has created roots that will assure its prevalence as the main source of publication in the main stream scientific literature, while no guarantee is attained that OA may complement it in such a way as to preserve its overall accepted virtues of credibility. Meanwhile, developed country authors might be inclined to remain in the cycle, and therefore, are not prone to become engaged actively in the OA movement until they are assured that in doing so his/her carrier will not be harmed.

Scientists from developing countries have closely emulated this pattern, but without a corresponding publishing infrastructure to sustain a proper participation of their journals. In this part of the world the business-driven scientific publisher is a scarce personage, because this enterprise can hardly be lucrative. Moreover governmental policies and financial support have not been sufficient to create sound national publishing infrastructures. As a consequence, a gap was created in regard to the steps of doing science: that of producing good journals. The major part of the scientific authors in these countries is less interested, or feeling less capable of participating in the international scientific publishing system. On the contrary, it became natural to these authors to accept that they play a secondary role in the process, privileging the submission of their final scientific product to the international system of publication, in which they have a shallow participation, and being pleased upon the acceptance of their manuscripts for publication.

As a consequence, producing good journals is frequently regarded as being of secondary importance in develop-

ing countries, if not for other reason, for the consciousness that it is a virtually unattainable goal to produce a journal of major international visibility and credibility. Governmental scientific agencies follow implicitly this vision and in Latin America no program has ever been proposed to change this scenario, ignoring the importance of the publication of journals in the science-making process. On the contrary, the adoption of the IF as a key indicator of scientific performance reinforces the scientific publication cycle and restrains the development of a national capacity to publish good journals. One example of the consequences of this negligence can be found in the club of the gatekeepers (editors) of important journals in the world. They have a tremendous influence in dictating the trends of their respective areas of activity and organizing the fitting of the results and ideas their journals publish in the frame of the established scientific knowledge. In a recent work, Braun and Dióspatonyi (2005) have studied the participation of scientists in the gatekeeper team responsible for the 240 top IF journals. It is really impressive to learn how underrepresented are the scientists from developing countries in this selective panel.

If it is considered how the peer-review practice has continuously improved the assessment of science, along with the efforts to produce good and reliable journals and how that, in turn, shaped the way for the progress of science as a whole, we may realize how much the developing countries isolation from carrying out this activity might have meant to render the cycle of doing good science incomplete.

Changing the Scenario of Making Good Scientific Journals in Developing Countries

Clearly, there is a need and a large space to be filled by developing countries to make good scientific journals. In

Latin America, several journals of good quality have been taken ahead by dedicated individual efforts and under limited budgets, due to the lack of a subscription market and the weak support from governmental agencies, as opposed to the large amount of money dispended to subscribe access to the journal collections commercialized by publishers from developed countries. But, with a few exceptions, the publication of good journals based on individual efforts and institutional support turned out to be little effective to generate a critical mass to improve and sustain the capacity to produce journals in the international mainstream.

Certainly, new approaches have to be considered. One of them is to create an OA collection of electronic versions of journals, covering some specific functions under the supervision of an umbrella organization. In 1997 the SciELO (Scientific Electronic Library Online; www.scielo.br) program was launched in Brazil by BIREME (Latin American and Caribbean Center on Health Science Information; www.bireme.br) affiliated to PAHO (Pan American Health Organization) and WHO (World Health Organization), in partnership with FAPESP (São Paulo State Foundation for Support to Science, Brazil), also supported since 2002 by the CNPq (National Science Research Council of Brazil).

The three main objectives of the program were:

i) To publish online a collection of the best Brazilian journals following the open access mode, according to which full-text articles could be freely accessed (Packer *et al.*, 1998; Meneghini, 2003). This would bring a wider national and international visibility to these journals. Interestingly, this was a desire expressed by some scientists of developed countries, interested in having access to the “lost science of the third world”, as claimed in the title of an article by Gibbs (1995). This aim was achieved,

TABLE III
SciELO DATABASE JOURNALS CITING OTHER JOURNALS

Categories of journals cited	Number (%) of journals cited	Number (%) of citations received	Citations/journals
SciELO	92 (0.62)	59250 (9.01)	644.0
ISI-non SciELO	5546 (37.33)	479331 (72.93)	86.4
Brazil-non SciELO	1269 (8.54)	31741 (4.83)	25.0
Non Brazil-non ISI	7946 (53.50)	86881 (13.22)	10.9
Total	14853 (100)	657203 (100)	44.2

Data refers to registers in August 30, 2005.

encompassing 176 journals and nearly 65000 articles by June 2006. The initiative was soon adopted by Chile and then spread over other Latin American and Iberian countries (www.scielo.org) covering over 350 journals. In fact, SciELO is the first experience of an OA initiative for a journal collection (Uhlir, 2005) and presently one of the largest ones, attaining over 15% of the peer-reviewed open access journals at the DOAJ (Directory of open access journals, http://www.doaj.org/). Overall, the OA model has been shown to afford an increase in the influx of citations (Eysenbach, 2006). SciELO seems not to be an exception (Alonso and Fernández-Juricic, 2002).

ii) To improve the quality of the journals in the countries that adopted SciELO with respect to several attributes like relevance of the articles, accuracy in the methodology, care in presentation and assessment of articles by *ad hoc* referees. All these requirements are judged for each journal by a special *ad hoc* panel. SciELO indexation turned out to draw the interest of most Latin American journals, emulating the attractiveness that JCR and related indexes generate in the international context. In fact, national research and education funding and evaluation institutions from Latin American countries are progressively ranking favorably SciELO indexed journals among national publications.

iii) To create a bibliometric/scientometric database, producing indicators similar to

those provided by ISI-JCR, for scientific and technological studies which had not been possible using the international databases only. This database allows systematic generation of data and documents that may be important to subsidize political decisions in the scientific arena. For instance, in a recent study using SciELO and JCR databases (Meneghini *et al.*, 2006) it was found that the SciELO/Brazil journals could be classified in two categories. One in which the journals have a tendency to cite and to be cited by authors of the national scientific community. The other one had a more accentuated trend to seek international visibility, both in terms of citing and being cited.

Journals representative of the first category belonged to the areas of agriculture, animal sciences, health sciences and tropical medicine. On the other hand, journals dealing with the basic sciences, physics, chemistry and biology, were more internationally oriented. This is an important issue since the Brazilian funding agencies have been very much inclined to privilege the Thomson Scientific indicators for their decisions, regardless of the scientific area. It seems clear that in certain areas scientific information exchange is prevalent among national scientists, as measured by the flow of citations. This trend

and the need to make it sustainable can now be considered by funding agencies so as to avoid the risk of bringing about a decline in the information exchange in the Brazilian context. It is likely that other developing countries face the same challenges

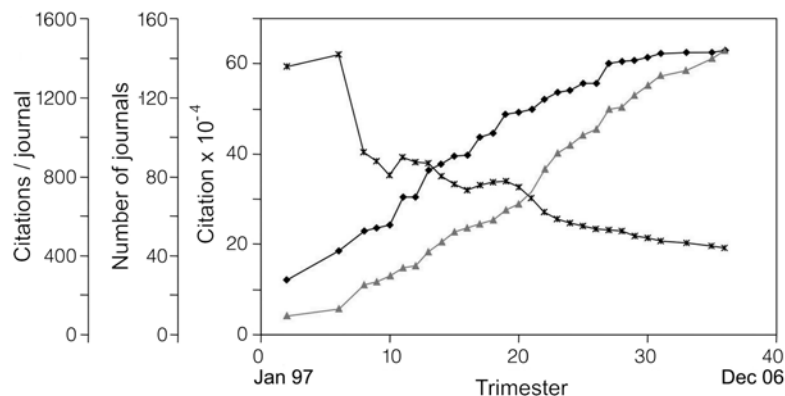


Figure 1. Bibliometric data on SciELO database for SciELO journals in Brazil (1997-2005). The dates refer to the time that a subset of journals were indexed in the database. ▲: number of journals, ◆: citations, *: citations / journal.

and could benefit of similar studies.

The increasing robustness of the SciELO scientometrics database (Table III) allows studies which would not be possible using solely the ISI database. The articles of the SciELO/Brazil journals have cited 14853 other journals, with a total of 657203 citations (registered until August 30, 2005); 92 out of these cited journals were SciELO journals, a minor percentage among the various categories of journals cited (0.92%) but, nevertheless, received 9% of the citations. A large number of ISI-non SciELO journals (5546) have been cited. How-

ever, in terms of citations per journal the SciELO journals are far ahead of the other categories. This is a reflection of an intense flow of citations among different journals in this database (Meneghini *et al.*, 2006).

Other important data to consider in Table III is the high number of Brazilian Journals (1269) that are not indexed in SciELO but, nevertheless, received a total of 4.8% of the citations. In fact, SciELO has achieved a point in which addition of further journals to the database appends minute increases in the number of citations received. This is clearly seen in Figure 1, and is regarded as being described by the Bradford's law (Bradford, 1934) which, in a broad sense, states that a

small core of journals have as many papers on a given subject as a much larger number of journals, n , which again has as many papers on the subject as n^2 journals. The Bradford's law can be transposed to citations as shown in Figure 1. It can be seen that 50% of the citations received by Brazilian journals in the SciELO/Brazil database can be ascribed to only 17 SciELO journals.

A Developing Country Perspective of Open Access

From the discussion above it can be inferred that the operation mode of the SciELO plat-

form implies its engagement in the international movement of OA to scientific information. This movement is new in the academic world and is still relatively unknown in developing countries. Those more closely aware of OA initiatives have a position that coincides in part with that of scholars in developed countries, but it goes beyond in some aspects. It is coincident with regard to the need of viewing the flow of scientific information from an ethical standpoint, in the sense that the asset of scientific and technological data and results created by research activity must be considered as a global public good, to benefit the whole mankind. As such, it should be offered in the most widespread access as possible, via the most effective mechanisms of electronic communication. In this sense, the more rational and challenging approach towards the strengthening of OA is to recognize the important role played by publishers, both commercial companies and scientific societies, and try to develop policies and business models that provide an equilibrium between the availability of scientific knowledge online and the prices to pay for it.

Another aspect of the open access phenomenon is peculiar

to developing countries. It has been mentioned above and has to do with these countries making their scientific literature more accessible and visible to the international scientific community. In general, the interest in the flow of scientific results towards the mainstream literature is strong in developing countries. Even so, there is a large number of scientists in these countries who make a choice in favor of publishing results in local journals. This is not necessarily an option to find an easier way to publish; it is a clear perception of a strong national and regional receptivity to their research results (Meneghini and Packer, 2007; Meneghini *et al.*, 2006). But then, why is it that scientists of developed countries would not be interested in these results? The choice of the community interested in an article defines the profile of the journals to be considered by the author and this choice might carry some dose of prejudice in regard, for instance, to the misconception of a lack of interest by a more international community (Gibbs, 1995).

How to evaluate a potential interest of a public that is not directly connected to that with which the author is more familiar with? This

is a hard question to answer. The Internet has turned this connection more attainable, but perhaps the best indicator of the success in this direction will be to achieve an increasing number of journals shared by both national and international journal indexes. Or, in other words, to pave the way towards the globalization of scientific communication.

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