Technological Basis for Information Science in Brazil: A Scientometric Study

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Abstract: The current study aims to investigate the scientific research on the technological theme and thus understand the basis of its support. It aims to outline the profile of scientific literature on technology in LIS through a descriptive and quantitative research based on scientometric studies of scientific communication. The source of the research was the Referential Database of Information Science Periodical Articles (BRAPCI) using the terms 'computer', 'automation', 'information systems', 'technology', 'electronic', 'e', 'digital' and 'virtual' gathered to analyze the technological base area of 353 articles. Results indicated that the articles were published between 1972 and 2008, outlining the year of 2001 with the largest quantity (29) and a decreasing setting in the last decade. The journal with the highest number of publications is *Information Science* (166); 82% of the authors have up to 2 published articles on technology, indicating that the subject has no homogeneous group work nor research continuity; and the most recurrent terms are "information" and "systems" and "technology". Seven thematic domain groups that constitute the technological basis of the field were identified: the most representative of them is led by 'information systems', followed by 'digital and virtual library'; policy issues involving 'internet and network'; 'computer teaching librarianship'; 'automatic indexing', 'knowledge management, and electronic publishing'.

1. Introduction

Any field of knowledge or field of professional practice is either directly or indirectly related to the modes of intellectual technology present in society. The development of new technologies is one of the driving forces that enabled changes in the basic curriculum of the librarianship courses in Brazil (Mueller, 1988). The technological revolution itself is known to have been an important factor that motivated the creation of information science (IS). According to

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certain authors, IS is inseparably connected to technology (Wersig, & Neveling, 1975; Saracevic, 1992; Capurro, 2003; Oliveira, 2005).

To Saracevic (1992), IS is a field devoted to "scientific inquiry and professional practice addressing the problems of effective communication of knowledge and knowledge records among humans in the context of social, institutional and/or individual uses of and needs for information. The author reinforces that "dealing with these matters, the field is particularly interested in benefitting, as much as possible, from modern information technology (Saracevic 1992, p.1).

After analyzing the post-graduation trends in the field during the late eighties, Mueller (1988) noticed the rising interest for modernization and introduction of technology in the field, both in teaching and in the means and tools for work During the following decade, the constant usage of technology and the emerging technological apparatus were pointed out by Oliveira (1998) as one of the causes that enabled research development in information science. To librarianship, the same decade was rich in discussions about the modern information professional. After 1996, in the first meeting of University Leaders of Librarianship Schools in Mercosul, technology started to be seen as the core of development of the librarian's professional practice and education. In the following meetings, both the Brazilian and foreign delegations expressed and reinforced the transversality of the technological axis in relation to the content of the other four graduation areas of the course (Theoretical Fundaments of Librarianship; Information Processing; Resource and Service Information; Information Unit Management) as well as Research. (Guimarães and Rodrigues, 2003).

There has been continuous effort on behalf of library and information science (LIS) towards accompanying and adapting to the development of technology in the appropriation, development, and evaluation as well as its in the theoretical, ethical and political discussion. Bearing this in mind, a question, which has motivated the following research, was been made: what is the profile of scientific production about technology in LIS in Brazil? Having the subject of 'technology' as the object of research and LIS as the scientific community to be studied, we intend to answer the aforementioned question with the aid of the scientometric study method, exploring the Base de dados Referencial de artigos de Periódicos em Ciência da Informação, BRAPCI (Referential Database of Science Information Articles and Science Magazines).

2. Scientometrics: a few studies

The field of Scientometrics derives from Bibliometrics.
It consists of applying quantitative methods to the study of scientific and technological progress, which is enabled by the analysis of articles, patents, theses and dissertations, as well as other kinds of scientific production (Vanti, 2002; Araújo & Alvarenga, 2011). Aside from that, the scientometric studies can be applied to the development of scientific policies, in both mediation of

production and productivity increase of a subject and by a research group of a field, in order to delineate the growth of a certain branch of knowledge (Tague-Sutckiffe, 1992; Araújo & Alvarenga, 2011). Stumpf and collaborators (2006) mapped scientometrics in Brazilian research and in the timeframe that goes from 1973 to 1995 identified 15 essays: One thesis, eight dissertations, four scientific magazine articles and two essay presented at events. One of the essays present at events had a topic as its subject of analysis, while all others discussed citations, summaries, scientific production, communication channels, articles and words from title.

In the usage of the scientometric method, Machado (2007) analyzed the theme of 'bibliometrics' published in five LIS Brazilian science magazines, in the early 1990's. The 31 articles were analyzed according to annual production, type, category and institutional filiation of the authors, nature and type of study, as well as theme. The majority of the articles it analyzed had only one author and has 'bibliometria' (bibliometrics) and 'citação' (citation) as the most frequent themes. Mattos (2013), among other things, tried to make a profile of the scientific community that has Brazil as a research topic with the aid of scientometric research. The author used the Scientific Electronic Library Online (SciELO), Social Science Citation Index (SSCI) and SCOPUS bases and found 2,766 articles about the theme. She also identified a disperse scientific community. Therefore, it was not possible to identify a research FRENTE (front). She also noticed a shy collaboration amongst researchers and preference for publishing in Brazil.

Souza and Maricato (2011), on the other hand, analyzed the theme of 'avaliação' (evaluation) in the context of LIS. The authors carried out the data gathering on BRAPCI, which allowed them to gather and classify 545 authors. Due to the dispersion found amongst authors the concluded that there was not an important nucleus of specialists working of the theme of "evaluation" in the field of LIS in Brazil. Similarly to these studied, other research pointed out by Mueller (2013) has presented itself as applied studies, aimed at, above all, analyzing and presenting document production in specific areas, as well as describing these literatures' characteristics.

3. Materials and Method

Mueller (2013) posits that most metric studies that have scientific articles as their unit of analysis use either a general or a specialized database. The BRAPCI was identified by the author as one of the referential bases of SI used by researchers in the field in order to carry out their metric studies. The same basis was used to gather data for the following research, with the aid of a manual search of terms that pertain to the theme of technology, in August/2013, with its variations as presented in Table 1, which quantitatively represents each term and the final result.

Table 1 – Research terms used

Terms (expressions)	Variations	Articles
autom*	*(automação;automatização;automático ; automática; automatizado; automatizada)*	52
informati*	*(informática; informatizado; informatizada; informatização)*	44
tecnologi*	*(tecnologia; tecnológico; tecnológica)*	154
Sistema* de informação	*(sistema; sistemas)*	64
digital*	*(digital; digitalização)*	40
virtual*	*(virtual; virtualização)*	23
eletronic*	(eletrônico; eletrônica)	43
Total		**420**

After reading and selecting items, a few repetitions and unrelated topics were found and removed from the list; 353 articles remained for the analysis, which was carried out with the aid of WordStats software. The study aimed at verifying their distribution according to publication date, science magazines, author, occurrence/incidence of terms and theme clustering.

4. Results and discussion

The articles were published between the years of 1972 and 2008, a 36-year period of publications. The production has shown itself to be asymmetric, varying from a minimum of one to a maximum of 29 articles. The average is 9.8 articles per year with a standard deviation of 8.1 articles per year and a median of 7 articles per year. According to Figure 1, the peak of the analysis is 2001, the year that, alone, had most publications (29). In the early 70's some of the lowest numbers are registered, a trend that remains similar until the year of 1985, when the largest number of publications (19) occurs, reaching a peak. After a decrease, numbers start rising to the peak again, which occurs in 1994? From 2004 on, publications start dropping. A considerable concentration of works about "informática" (science information), "automação"(automation) and "bases de dados"(database) were published in the year of 1985, especially in Revista de Biblioteconomia de Brasilia, which featured 12 out of the 19 works.

Figure 1 – Distribution of articles according to year of publication
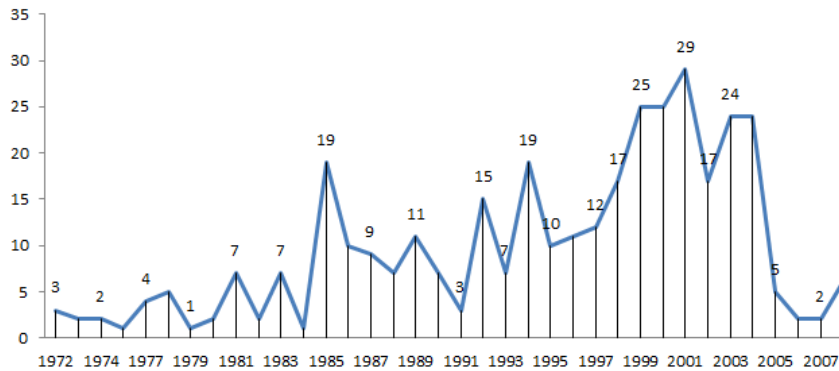
In 1994, on the other hand, publications about the aforementioned themes plummeted, along with the surging of new terminologies such as "tecnologia da informção" (technology information) and " transferência tecnológica" (technological transference), especially in the science magazine "Revista Ciência", which published 17 out of 19 articles found. 2001's peak might be considered a terminological evolution. That, because the search descriptors used did not fully comprehend the technology- related studies in the area, given the dynamics and evolution of technology. The scientific production about technology is distributed between 14 science magazines, as presented in Figure 2.

The science magazine *Ciência da Informação*, first and one of the main Brazilian LIS science magazines, has had the majority of them: 166 articles, which is the equivalent of 47,03% of the total. This considerably outnumbers the rest: it is three times higher than the second, *Revista de Biblioteconomia de Brasília*, which published 47 articles (13.31%).
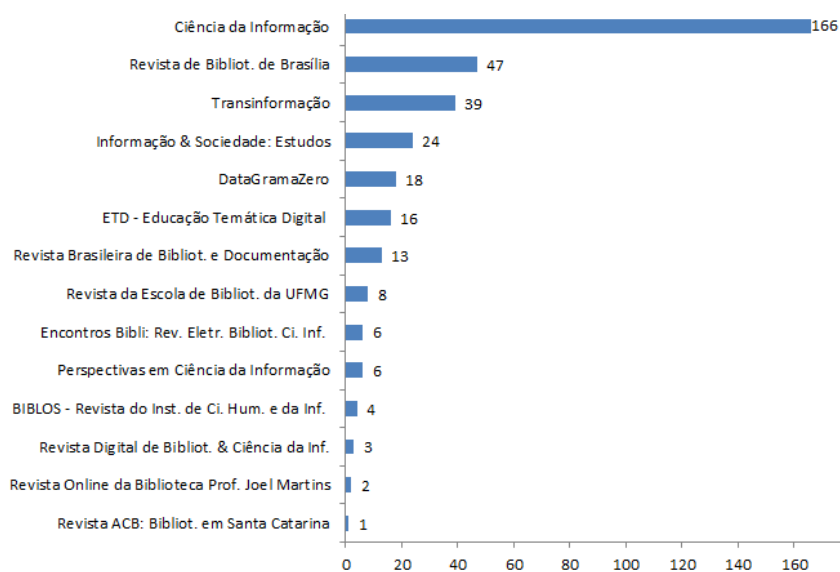
Figure 2 – Distribution of articles per science journal

The 353 articles were written by 535 people, the majority of them being single-authors, which indicates low collaboration in technology-related production. A small group with a larger number of publications was found to exist, which leads to considering that that group has influence over the theme analyzed. Table 2 presents the total of authors distributed according to the number of works they did. Authors with only 1, 2 or 3 articles were included in the sum, but their names were not included in the chart.

Table 2 – Author-article relation

Ref	Autor	Artigos	(%)
1	MARCONDES, Carlos Henrique	8	1.50
2	CUNHA, Murilo Bastos da	7	1.31
3	SAYÃO, Luís Fernando	6	1.12
4	FIGUEIREDO, Nice Menezes	6	1.12
5	PONTES, Cecília Carmen Cunha	5	0.93
6	ROBREDO, Jaime	4	0.75
7	TARGINO, Maria das Graças	4	0.75
8	17 Autores com 3 artigos	51	9.53
9	66 Autores com 2 artigos	132	24.67
10	312 Autores com 1 artigo	312	58.32
Total		**535**	**100**

Authors who published up to three articles about technology in LIS, come up to a total of 495 articles taken into consideration together, and represent 92.52% of the total of authors. The situation does not allow reaching the conclusion that there is a research front about the theme. Contrarily, it reveals discontinued scientific production. One of the justifications to that might be the dynamics/transversal aspect of technology (Guimarães & Rodrigues, 2003) as well as the multiplicity of possibilities to apply the technological component, which makes it a part of several different themes in the field of LIS

Even amongst the authors who wrote the majority of articles, it is possible to notice the aforementioned phenomenon. The first three authors have an educational and professional background in technology. They have in common, for instance, discussions about 'biblioteca digital' (online library), which feature even full books and chapters, as well as articles produced as co-authors.

The fourth in the rank has not had an educational background in technology. However, she originally dedicated herself to themes such as 'formação e desenvolvimento de coleções'(forming and developing collections), 'estudos de usuários' (user study) and 'serviços de referência' (reference services). Observing the evolution of those discussions led the writer to reflect and approach the evolution of those themes and their connection with technology. For example, she describes the impact of new technologies in the process of forming collections (Figueiredo, 1966) and also studies of users with support for planning and evaluation of information systems (Figueiredo, 1985).

Another factor that may endorse the thesis that there is discontinuity in research about technology during the time studied is the belated creation of a work group dedicated to technology-related research. That did not happen until the year of 2008, when GT8 Informação e Techonologia was created. The work group is affiliated with the most important LIS event in Brazil, Encontro Nacional de Pesquisa em Ciência da Informação (ENANCIB).

Bibliometrics and scientometrics have been the most frequent techniques used for measuring. These studies are quantitative and therefore assess amount, occurrence, and incidente (Mueller, 2013, p.8). In order to provide better understanding of the contents presented in technology publications, there has been an extraction of the title, key words and summary of each article. WordStats was used in the sistematization of them.
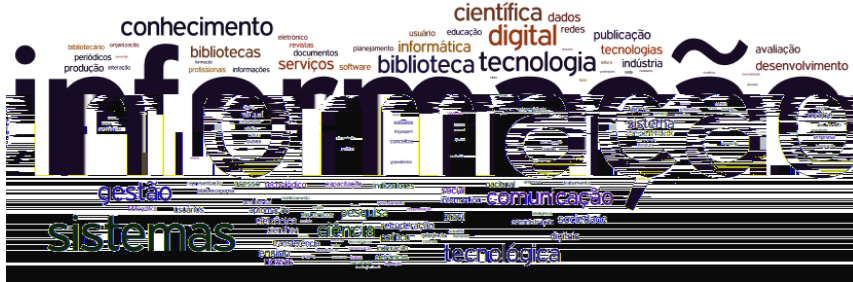
Figure 3 - Most frequent terms

Wordstats report presented a total of 1,394 valid words, amongst which the following have had the most frequent occurrence: 'informação' (information) (312), 'sistemas' (systems) (70), 'tecnologia' (technology) (70), 'biblioteca' (library). (69) In Figure 3, elaborated by Manyeyes, it is possible to notice a cloud of these terms around the other ones.

Finally, in order to better understand the reach of those publications, WordStats has generated a dendogram with a clusterization by approximation of co-occurrence, as presented in Figure 4.
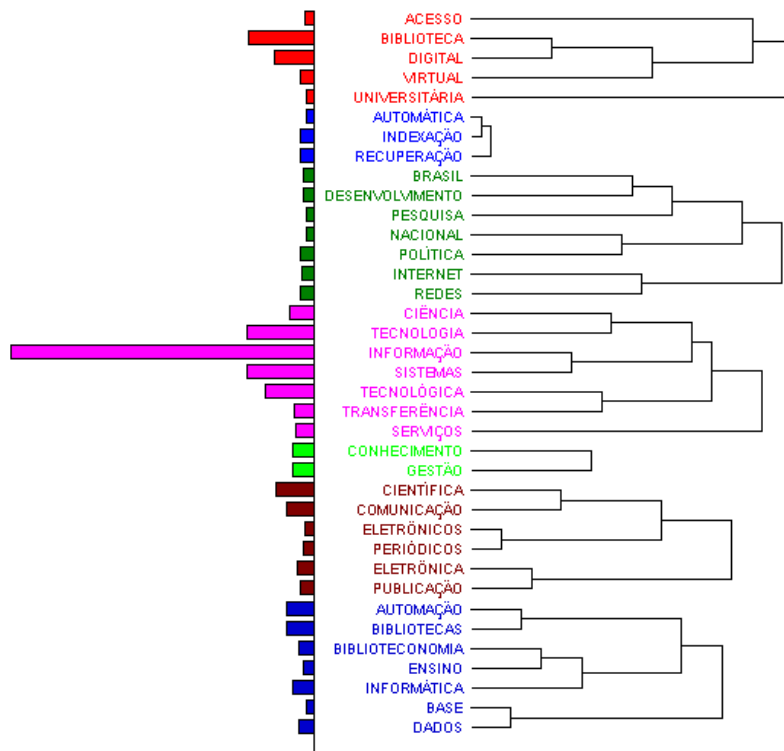

Figure 4 - Clustering of most frequent terms

As presented in the dendogram, it is possible to notice the relationship between

investigate the types of approach to which technology is applied (humanistic, technicist, sociotechnical).

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