BIBLIOMETRIC ANALYSIS OF PUBLICATIONS FROM SCIENCE, TECHNOLOGY AND SOCIETY PROGRAM OF THE FEDERAL UNIVERSITY OF SÃO CARLOS

ANÁLISE BIBLIOMÉTRICA DAS PUBLICAÇÕES DO PROGRAMA DE CIÊNCIA, TECNOLOGIA E SOCIEDADE DA UNIVERSIDADE FEDERAL DE SÃO CARLOS

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ABSTRACT

This survey was part of a study whose purpose was to analyze the theory that defines the field Science, Technology, and Society (CTS). The survey provided an overview of the development of the Program itself, related to the scientific production of its professors and students, contributing to advances in the scientific and interdisciplinary field. The survey about the scientific publications developed in the Graduate Program in Science, Technology and Society of the Federal University of São Carlos was based on bibliometric analysis of the main terms present in the titles and keywords of publications, such as scientific papers, thesis, dissertations and book chapters of professors and students of the program. By using tables, graphs and word clouds, the main terms pointed out by the doctoral students from the 2018 class were represented, as well as the number of publications per year, since the beginning of the Program (2008 - 2016), and the diversity of themes in which the study is inserted, which allowed an analysis of the profile of the research performed so far. It was concluded that there has been a significant increase in Program's publications with respect to scientific papers published in the most diverse journals. Regarding book chapters, there has been a decrease in publications, probably due to the Program's incentive for researchers to publish papers in high-impact scientific journals. The study also showed a higher number of female than male students, and an equivalent number of men and women among adiviser in the Program. The main terms found in this survey are "scientific communication", in thesis and dissertations, "competitive intelligence", in book chapters, and "memory", in papers published in journals.

KEYWORDS

Bibliology. Science and Society. Technology. Publishing.

RESUMO

Este levantamento fez parte de um estudo que objetivou analisar a teoria que define o campo Ciência Tecnologia e Sociedade (CTS). A pesquisa permitiu a visualização de um panorama do desenvolvimento do próprio Programa no que diz respeito à produção científica de seus docentes e discentes colaborando para um avanço no campo científico e interdisciplinar. O levantamento acerca das publicações científicas provenientes do Programa de Pós-Graduação em Ciência, Tecnologia e Sociedade da Universidade Federal de São Carlos foi realizado tendo como base a análise bibliométrica dos principais termos presentes nos títulos e palavras-chave de publicações que incluem artigos, teses, dissertações e capítulos de livros de discentes e docentes do programa. Utilizando de tabelas, gráficos e nuvens de palavras, foram representados os principais termos apontados pelos doutorandos em uma disciplina, ingressantes da turma de 2018, bem como, pôde-se localizar a quantidade de publicações por ano, considerando o início do Programa, 2008 até 2016, e a diversidade de temas que as pesquisas se inserem, o que permitiu uma análise do perfil das pesquisas realizadas até o momento. Conclui-se que houve um aumento significativo nas publicações do Programa no que diz respeito aos artigos científicos publicados nos mais diversos periódicos. Já com relação aos capítulos de livros houve um decréscimo de publicações provavelmente pelo fato do incentivo do Programa para que os pesquisadores publiquem artigos em revistas científicas de alto impacto. O estudo também mostrou um número maior de discentes do sexo feminino do que masculino e um número equivalente de homens e mulheres entre os docentes que orientam no Programa. Os principais termos encontrados nas pesquisas são comunicação científica nas teses e dissertações, inteligência competitiva nos capítulos de livros e memória nos artigos publicados em periódicos.

PALAVRAS-CHAVE

Bibliometria. Ciência e Sociedade. Tecnologia. Publicações.

1 Introduction

Bibliometrics is based on counting scientific articles, patents and citations. Depending on the purpose of the bibliometric study, both the text that makes up the publication and the elements present in records about publications extracted from bibliographic databases can be considered as data, such as authors' names, title, source, language, keywords, classifications. and quotes (RAO, 1986; ZHU et al., 1999).

Corroborating the concept detailed above, this research presents a bibliometric survey of the scientific production of researchers from the Programa de Pós-Graduação em Ciência, Tecnologia e Sociedade (PPGCTS), directly translated as the Graduate Program in Science, Technology and Society from 2008 to 2016. This production translates into theses and dissertations from the program, book chapters and articles published in scientific journals.

The PPGCTS was created in 2007 and started its first PhD student class in 2013. The main objective of the program is to form masters and doctors in Science, Technology and Society for research development, the exercise of teaching and professional activities in the areas associated with the Social Dimensions of Science and Technology, Technological Management and Sustainable Society, and Languages, Communication and Science. To understand the impacts of science and technology that extend to the economic, professional, educational, social and institutional spheres of contemporary society, it is necessary to deepen the knowledge about Science, Technology and Society (STS) relations, which is an interdisciplinary objective shared by various disciplines. Social, educational and cultural asymmetries also lead to a poor understanding by society about science and technology, their uses and impacts on their lives. Wherefore, the formation of human resources – professionals, researchers and teachers with a better understanding of the interrelations between Science, Technology and Society – becomes relevant for Brazilian society and organizations, in order to contribute to the solution. of today's economic, social and environmental challenges (PPGCTS, 2019).

The survey was part of a study that aimed to analyze the theory that defines the field Science Technology and Society (STS). The research allowed the visualization of an overview of the development of the Program itself regarding the scientific production of its teachers and students, contributing to a breakthrough in this scientific and interdisciplinary field.

Another point to analyze about the profile of a field is related to the analysis generated by gender studies, which contribute to investigate barriers placed on men and women in the performance of certain fields. These segregation barriers can have vertical or horizontal origin according to Olinto (2012). The author also points:

> Through horizontal segregation women are made to make choices and follow markedly different paths from those chosen or followed by men ... Horizontal segregation includes mechanisms that make career choices markedly gendered. As female occupations tend to be less valued in the labor market, it is considered that women's horizontal segregation is related to another type of vertical segregation. Vertical segregation is perhaps an even more subtle, more invisible social mechanism that tends to keep women in more subordinate positions or, in other words, not to advance their career choices (OLINTO, 2012, p. 69, our translation).

Regarding horizontal segregation this disparity can be found in the separation of female participation between the different disciplines, as emphasized by Schiebinger (2001) and Yannoulas (2007):

> Today women are concentrated in what are known as soft sciences: life and behavioral sciences and social sciences where wages are relatively low, regardless of gender. Few women are found in the hard or physical sciences whose prestige and pay are high (SCHIEBINGER, 2001, p. 78, our translation) .

> There is a tendency to group university students in disciplines related to services, such as the Communication, Education, Humanities and Health professions. Careers most strongly linked to production, such as Agricultural Sciences and Engineering, remain with fundamentally male student body (YANNOULAS, 2007, p. 4, our translation)

In the PPGCTS the initial training of researchers is diverse and it would be fitting a broader study about their formation by integrating an Interdisciplinary Graduate Program where the researches are also of the most diverse. Among the women who join in 2018 the referred Program are librarians, journalists, IT analysts, nutritionists, biologists, tourists, among others. The very interdisciplinary character of the program attracts researchers with the most diverse backgrounds.

2 Methodological Procedures

One of the most important challenges for Brazilian science in the 21st century is to achieve greater global impact for knowledge originating in the country. Quality scientific production requires collaboration among the most capable scientists (CRUZ, 2011), and can be measured by the use of instruments. One of these tools is Bibliometrics, which allows us to observe the state of science and technology throughout the entire scientific production, assigning a level of specialization. This means that it allows us to situate the country in relation to the world, an institution in relation to the country, and an individual scientist in relation to its scientific community. (OKUBO, 1997).

Bibliometrics emerges as a way to follow the development of science, or at least, an area of knowledge against the perception of scientists when the amount of scientific knowledge generated exceeded the ability to read (ROSTAING, 1996). This tool involves

various measurements of literature, documents and other types of documentation while scientometry involves productivity and scientific use by making an assessment of scientific production through numerical indicators of publications, patents, among others. (SPINAK, 1998).

From a set of terms related to the main research themes developed by incoming PhD students in 2018 and terms listed according to topics covered in the STS field, in addition to variant terms relating to theory or plural spelling, a crossover was made in the in order to identify which and how many of these terms were cited in the keywords of theses and dissertations, book chapters and articles published in scientific journals. Thus locating the new works within the history present in the program publications.

The terms[1] raised and used in the searches are listed in table 1 below.:

Table 1. List of terms used to make the bibliometric study

Termos-1	Termos-2	Termos-3
Economia evolucionista		
Economia da tecnologia	Institucionalismo	Neo-institucionalismo
Construtivismo social	Abordagem normativa	
Sociologia do conhecimento		
Teoria **ator-rede**	Teoria do **campo científico**	
Modelo tríplice-hélice	Novo modo de produção do conhecimento	
Comunicação Pública da Ciência	Compreensão Pública da Ciência	**Comunicação Científica**
Sociologia Ambiental	Teoria da modernização ecológica	
Modernidade reflexiva	Sociedade de risco	
Teoria de **gênero**		
Pós-modernismo	Pós-colonialismo	
Teoria das representações sociais	**Representação social**	
Identidade		
Tecnologia social	**Tecnologias sociais**	
Política pública	Política pública CTS	**Políticas públicas**
PO		
Inteligência coletiva		
Etnografia		
Memória		

Source: research results.

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[1] The terms was not translated because the research was made with the keywords in portuguese. The same search with the terms in English could generate a different result.

From these terms listed above, searches were performed considering the titles and keywords of publications of articles in scientific journals, book chapters and theses and dissertations from the PPGCTS.

The first stage of the survey consisted of analyzing the theses and dissertations documents of the Program deposited in the institutional repository of UFSCar. The repository website allows the search to be performed using as a filter the CNPq graduate program, subject, author, adiviser, title, date, document type and areas. Through a request to the sector responsible for inserting theses and dissertations in the repository linked to the UFSCar Community Library (BCo) and also to the General Secretariat of Informatics (SIn), it was possible to have access to a report that also included the words key of the works.

The UFSCar Institutional Repository (IR UFSCar) is an information system that aims to store, preserve, organize and widely disseminate the intellectual production of the various sectors and segments of the UFSCar community, providing open access to information produced in the institution and registered as scientific, technological, didactic, artistic-cultural and technical-administrative (RI UFSCAR, 2018).

In the second stage of the survey, the book chapters published in the program were selected considering the titles of the works as a whole, the chapters and their authors. In this case, because the publications do not contain keywords the crossover of terms has been removed from the titles.

Therefore, we searched the articles published in scientific journals between 2013 and 2016, from a list of these publications available on the program's own site with information about the authors, article title, journal title, volume, number and year. Based on this information, the article was searched either through the Capes portal, or through the magazines' websites, thus retrieving, in most cases, the keywords of the publications. For data insertion and tabulation a spreadsheet editing application was used in order to count them, generate the final results and the graphs that will be presented below.

3 Results

In order to start presenting the results, follow Graph 1 below which compiles the number of publications of the mentioned modalities per year (from 2008 to 2016) of the referred Program. The results show the total volume of Program publications by type of publication, which are: articles, book chapters, theses and dissertations.

Graph 1. Volume of publications between articles, book chapters, theses and dissertations
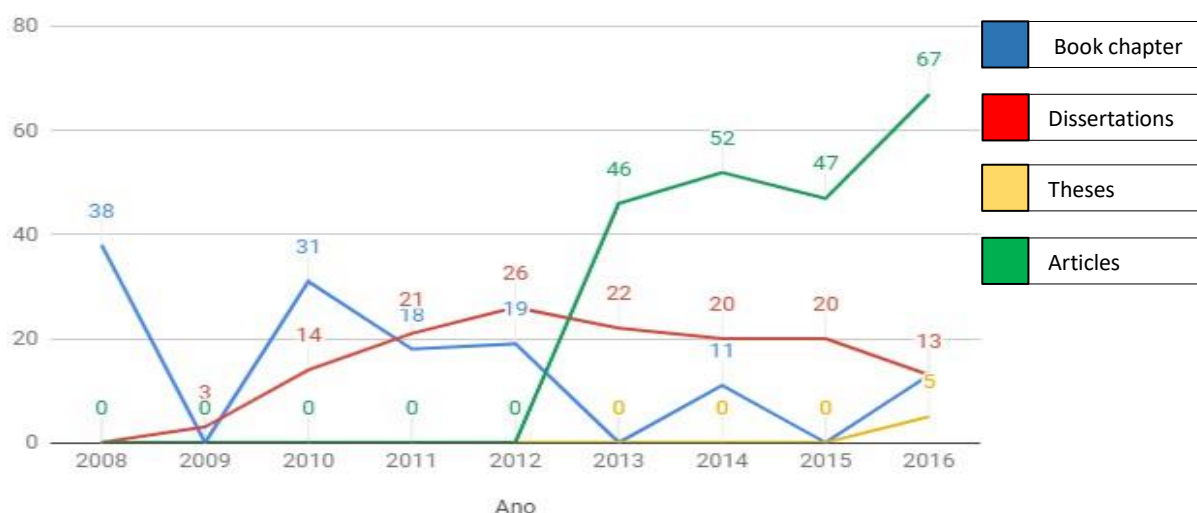
Source: research results.

It is possible to see an increase in the publication of articles in journals from 2012 onward while the volume of book chapter publications decreased. Possibly, this is due to changes linked to Capes requirements regarding the quadrennial evaluation of postgraduate programs where the publication of articles in well-evaluated scientific journals in which Capes raises program grades. The year 2017 was not considered, as several publications are in press or not yet computed with the PPGCTS.

According to Kawasaki (2017, p. 110) "qualified publication of journal articles as well as chapters and books are on the rise and have a significant discriminatory effect on Program performance". Publication in annals of events, chapters, and books has low weight over journal articles and patents.

There was also a growth in the number of theses and dissertations defended in the Program reflecting the growth of the Program itself over time. The first class of PhD students started their studies in 2013 and the first thesis defenses took place in 2016, as well as the dissertation defenses, the first being defended in 2009.

In addition to the graphics, word clouds were also used. According to Silva (2013) word clouds are various terms used for a certain type of visualization where each word has its size oriented by relevance in a given corpus of text. This is usually a simple count of occurrences of a given word in the text. The tool was useful to visually demonstrate the concentration of some terms when the possibilities are very varied, as in the authorship of the works and keywords used.

The following are the word cloud illustrations created from the titles and keywords of the book chapter publications, articles, and dissertation and thesis. In the case of book chapters, as already mentioned, there were no keywords available, so titles searches were used only. For the other publications, articles and dissertations and theses, the terms contained in Table 1 were used.

Figure 1. Word cloud found in chapter titles

Source: research results.

In the word clouds presented in Figure 1 above in the book chapter mode, it is possible to identify the terms that appear frequently as science, technology, society, technological, scientific, innovation, education, communication, STS among others.

**Figure 2.** Cloud of words found in the titles and keywords of article publications.

Source: research results.

Meanwhile in the Figure 2 in the modality of articles, we also have the incidence of science, education, STS, information, as well as new terms: health, production, knowledge, technology, language, virtual networks, among others.

Figure 3. Cloud of words found in the titles and keywords attributed
by the authors in the dissertation and thesis publications

Source: research results.

In Figure 3 in dissertations and theses, some words are repeated, as there are also new terms such as: indicators, economics, patents, software, companies, among others.

It is observed that the words repeated in the 3 clouds are: science, scientific, education, STS, information. The highlighted words show the variety of topics researched in PPGCTS, however, highlights the focus in some fields.

Among the terms found in the theses and dissertations the most expressive were scientific communication, competitive intelligence, public policy and social technology followed by public communication of science, gender and memory as shown in Graph 2 below.

Graph 2. Main terms found in theses and dissertations

Source: research results.

Regarding to book chapters the most frequently appearing terms were also competitive intelligence and public communication of science along with social technology as noted in Graph 3 below:
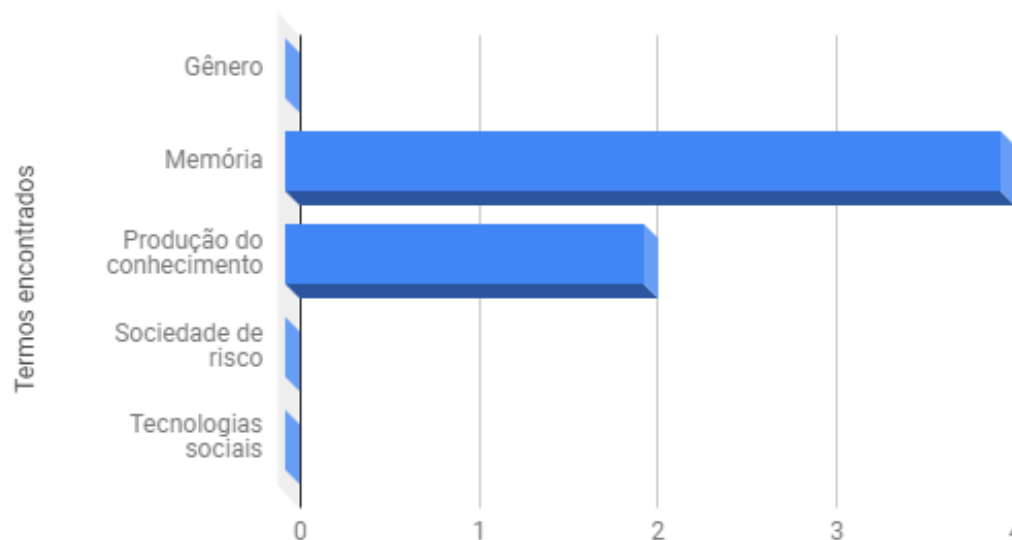
Graph 3. Number of terms found in book chapters
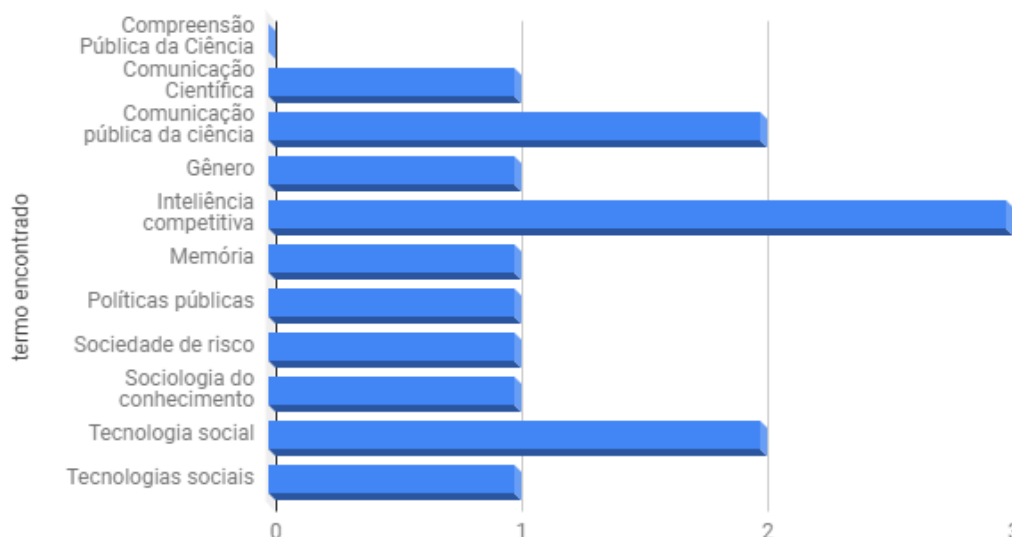
Source: research results.

In the publication of articles in scientific journals, the terms memory and knowledge production are more expressive, followed by the terms gender, risk society and social technologies, as shown in Chart 4 below:

Graph 4. Number of terms found in articles.

Source: research results.

It was observed that the classification of keywords in the articles was not so accurate, as it differs greatly from what was found in articles, dissertations and theses. From the terms found, we can see that in book publications, dissertations and theses, there is a repetition of the words: scientific communication, public communication of science, competitive intelligence and social technology. The common keyword found in article and book publications was memory. Comparing the publications of articles with dissertations and theses no repetition was observed.

Below is an illustration of the terms found in all types of publications, and the number that appears in front of the term is the number of times the term appears. For terms where no digit appears the term was not found:

Table 2. List of terms found in the publications of the UFSCar Graduate Program in Science, Technology and Society

Teses e dissertações	Capítulo de livros	Artigos em periódicos
Ator-rede (1)	Compreensão Pública da Ciência	Gênero
Campo científico (1)	Comunicação científica (1)	Memoria (4)
Comunicação científica (6)	Comunicação pública da ciência (2)	Produção do conhecimento (2)
Comunicação pública da ciência (3)	Genero (1)	Sociedade de risco
Gênero (3)	Inteligência competitiva (3)	Tecnologias sociais
Identidade (2)	Memória (1)	
Inteligência competitiva (5)	Políticas públicas (1)	
Memória (3)	Sociedade de risco (1)	
Política pública (1)	Sociologia do conhecimento (1)	
Políticas públicas (4)	Tecnologia social (2)	
Sociologia ambiental (1)	Tecnologias sociais (1)	
Tecnologia social (4)		

Source: research results.

Regarding gender research in thesis and dissertation publications we found the following results:

Graph 5. Proportion among students by gender in PPGCTS.
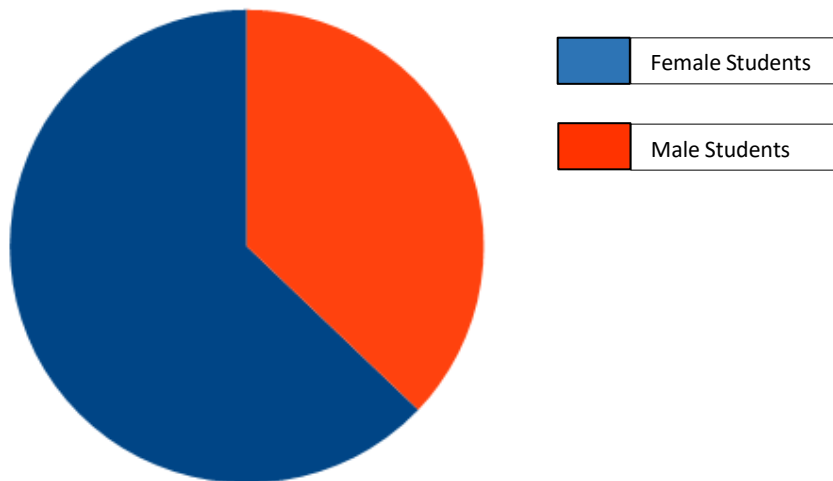
Source: research results.

Among the program publications it can be observed that there is a female majority among the students. Taking into account that the course has a predominance of disciplines in human / social areas this difference reiterates the horizontal gender segregation demonstrating a female predominance in those areas, which is not maintained among students, at least in the publication of theses and dissertations. Indicating a possibility of vertical segregation where it seems more difficult for women to become students / adivisers in the female majority course. As pointed out by Schiebinger (2001), Yannoulas (2007) and Olinto (2012).

Graph 6 – Proportion of adivisers / students by gender in PPGCTS.
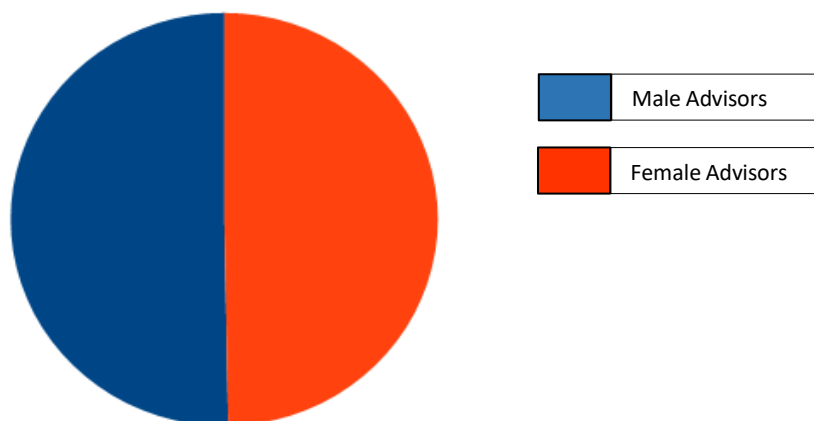
Source: research results.

In the graph above we observe that among the program publications the number of adivisers is practically the same. Which raises the question about the vertical gender disparity that if there is a female majority among students than why we do not observe the same difference between adivisers.

4 Final Considerations

The objective of this study regarding the bibliometric survey to analyze the main themes that define the field Science, Technology and Society (STS) about scientific publications from the Graduate Program in Science, Technology and Society, was met, and consequently, Some results could be observed and will be explained below.

A variety of related terms from different theories and subjects of study have been observed both in the publication of articles and book chapters as well as in dissertations and theses. This diversity may be related to the fact that the Program has an interdisciplinary character encompassing studies in the most diverse areas of knowledge.

According to Okubo (1997), it was possible, through bibliometrics, to locate the main themes used by the doctoral students of the 2018 class in relation to the published works of the program through the search for keywords. In addition to starting to identify some patterns and relevance of subjects in publications through word clouds, as proposed by Silva (2013).

The term that most appeared in theses and dissertations was scientific communication. This fact may be related to the fact that in recent years, and especially in the current political moment, the academy as a whole has been discussing more broadly the importance of scientific communication not only among peers, but mainly with society in order to reaffirm the importance of scientific development and even funding for research.

Among the articles published in scientific journals the term that appeared most was memory. Camargo and Goulart (2015) point out that from the 1980s onwards, memory centers linked to public and private organizations began to emerge and although there is no more accurate data on this, it is possible to draw a parallel of the numerical growth of these memory centers. memory to elements of conjuncture that bring up the need to preserve the culture and identity of organizations. The term memory itself is quite broad in meaning so that publications may be related to institutional memory, cultural memory, scientific memory, among others.

Regarding book chapters, the most prominent term was competitive intelligence, however, this type of publication in the Program had a decrease in the number of publications while articles and theses and dissertations had an increase that in the case of the latter is

linked to its own program growth in student numbers.

Even with a female majority among the students of the Program, a female majority can be observed among the students and an egalitarian division in the adivisers indicating a clue (which needs to be further investigated) of horizontal gender segregation, by segregation of areas and vertical by gender. This does not remain in a more prominent position, which is that of teaching / guidance. We may suggest as future studies a broader gender analysis (including more clipping such as race) that encompasses productivity analysis, recognition, and segregation in the PPGCTS program and other interdisciplinary programs to profile their limitations in this field. Thus, gender analysis would also be interesting for publications such as books and articles, which could complement this analysis.

Through this study it was possible to observe the importance of choosing the title and keywords of a publication, because it was through them that the work was guided. In this sense, researchers play a very important role in scientific dissemination by influencing the retrieval of results found in database searches by other researchers in future times. The choice of keywords is crucial in retrieving academic papers indexed in databases and identifies by which theme a work will be recognized when retrieved. From the keywords found, it is possible to infer that PPGCTS complies with its comprehensive and multidisciplinary proposal, as there are researches addressing the most diverse topics such as memory, competitive intelligence, science, education, gender, social technologies, health, among others. The STS field still appears shyly.

For future work we can consider a comparative analysis with the products generated by other graduate programs with similar proposals, besides adding other factors such as the observation of terms used in abstracts, concentration of publications with certain themes, author relationship and co-authoring, among others.

References

CAMARGO, A. M.; GOULART, S. **Centros de memória**: uma proposta de definição. São Paulo: Edições SESC São Paulo, 2015.

CRUZ, C. H. B. Desafios e estratégias para a cooperação internacional em pesquisa no Brasil e as FAPs. **Revista Eletrônica de Jornalismo Científico**, Campinas, jun. 2011. Disponível em: http://www.comciencia.br/comciencia/?section=8&edicao=67&id =852. Acesso em: 10 set. 2018.

KAWASAKI, B. C. Critérios da avaliação Capes para programas de pós-graduação. **Revista Adusp**, São Paulo, v. 60, p. 102 - 117, 01 maio 2017.

OKUBO, Y. **Bibliometric indicators and analysis of research systems**: methods and examples. Paris: OECD, 1997. Disponível em: http://www.oecd-ilibrary.org/ docserver/download/fulltext/5lgsjhvj7ng0.pdf?expires=1308322145&id=id&accname=guest &checksum=BAFB93375234F0FCD0CBA6DA4E2BC1DA. Acesso em: 24 ago. 2018.

OLINTO, G. A inclusão das mulheres nas carreiras de ciência e tecnologia no Brasil. **Inclusão Social**, Brasília, v. 5, n. 1, p. 68–77, 2012. Disponível em: revista.ibict.br/inclusao/article/view/1667. Acesso em: 25 de fev. 2019.

PPGCTS. Histórico. Disponível em: http://www.ppgcts.ufscar.br/apresentacao. Acesso em: 18 ago. 2019.

RAO, I. K. **Métodos quantitativos em biblioteconomia e ciência da informação**. Brasília: ABDF, 1986.

RI UFSCAR. Sobre o repositório. Disponível em: https://repositorio.ufscar.br/. Acesso em: 10 set. 2018.

ROSTAING, H. **La bibliométrie et ses techniques**. Collection "Outils et méthodes", co-édition sciences de la societé et CRRM - Centre de Recherche Rétrospective de Marseille. Marseille. 1996.

SCHIEBINGER, L. **O feminismo mudou a ciência?**. Tradução Raul Fiker. Bauru: EDUSC, 2001. 384 p.

SILVA, T. **O que se esconde por trás de uma nuvem de palavras?** 2013. In: Blog Tarcízio Silva. Disponível em: http://tarciziosilva.com.br/blog/o-que-se-esconde-por-tras-de-uma-nuvem-de-palavras/. Acesso em: 09 set. 2017.

SPINAK, E. Indicadores cienciométricos. **Ciência da Informação**, Brasília, DF, v. 27, n. 2, p. 141-148, 1998.

YANNOULAS, S. Mulheres e Ciência. **Scielo**, SérieAnis, n. 47, p. 1–10, 2007.

ZHU, D. et al. A process for mining science & technology documents databases illustred for the case of knowledge discovery and data mining. **Ciência da Informação,** Brasília, DF, v. 28, n.1, jan. 1999. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-19651999000100002. Acesso em: 08 jun. 2018.