DIALOGUES BETWEEN SOCIOLOGICAL STUDIES AND INFORMATION SCIENCE IN BRAZIL: domain analysis

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Abstract

This study aims to present aspects of approximation between sociological studies on knowledge, science and scientific knowledge and Information Science, found in the periodic scientific production of a universe of 98 Productivity Fellows in Brazil. We aimed to identify the referent authors from the sociological fields that focus on knowledge, science, and scientific knowledge featured in this production; to highlight similarities or differences between the researchers and the referent authors; and to diachronically analyze the presence and coupling of the authors from these three sociological fields in the periodical production of the PQ fellows. As methodological procedures, we situated the PQs within the fields, starting with a priori classification, and identified the presence of these authors by performing searches in Brapci, based on their scientific productions, pointing out the coupling relations between citing authors and the most cited referents. Results show Castells, Bourdieu, Cronin, Popper, and Merton as the most cited sociologists, and we also produced an adjacency matrix to verify the most cited sociologists in each of the fields. We built the network of referents to expose the coupling relations between them and the PQs. We conclude this article by highlighting the presence of the authors cited in the PQs' productions in all categories, and the identification of the dynamics of scientific production within its movements, based on the analytical procedures.

Keywords: Sociology of Knowledge. Sociology of Science. Sociology of Scientific Knowledge. Domain Analysis.

Resumo

Objetiva apresentar aspectos de aproximação entre os estudos sociológicos sobre o conhecimento, a ciência e o conhecimento científico e a Ciência da Informação, encontrados na produção científica periódica de um universo de 98 Bolsistas de Produtividade (PQ) do CNPq em Ciência da Informação no Brasil. Como intenções subsidiárias, visa identificar os autores referentes das correntes sociológicas voltadas ao conhecimento, à ciência e ao conhecimento científico presentes nessa produção; evidenciar similaridades ou distanciamentos entre os pesquisadores e os autores referentes; analisar diacronicamente a presença dos autores das três vertentes na produção periódica dos bolsistas PQ e identificar o acoplamento de autores referentes a essas três vertentes sociológicas. Como procedimentos metodológicos, situa os pesquisadores PQ segundo as vertentes da sociologia, partindo de classificação a priori. Identifica a presença destes autores realizando buscas na Brapci, a partir da produção científica dos bolsistas PQ, apontando as relações de acoplamento entre autores citantes e os referentes mais citados. Apresenta, como resultados, o destaque para Castells, Bourdieu, Cronin, Popper e Merton, com maior número de citações e a matriz de adjacência, de forma a verificar os sociólogos mais citados em cada uma das vertentes. Constrói a rede dos referentes, com o objetivo de explicitar as relações entre eles e os PQs por eles acoplados. Conclui a partir dos procedimentos analíticos, a presença dos autores citados nas produções do PQs em todas as categorias, e a identificação da dinâmica da produção científica em seus movimentos.

Palavras-chave: Sociologia do Conhecimento. Sociologia da Ciência. Sociologia do conhecimento científico. Análise de Domínio.

1 Introduction

To better understand Information Science (IS) – besides the possible use of studies on theoretical and methodological aspects present in the literature of this field, considered in its socio-historical dimension –, domain analysis (DA) has turned to scientific production, acting in a broad spectrum of possibilities, theoretical and methodological references. We can thus recognize its institutionalization as a science in process in the composition of a history of creations and discoveries, in which specific knowledge domains are constituted and strengthened through the efforts of scientific production, the laws and theories developed, and their foundations. In advocating as indispensable the "[…] formation of a coherent scientific research domain," Lloyd (1995 p. 18) argues that the validity of a scientific study lies in seeking to articulate an empirical investigation within a theoretical and methodological framework that will lead to the understanding and explanation of the objects of investigation

This study thus describes aspects of proximity between sociological studies on knowledge, science, and scientific knowledge and Information Science (IS), found in the periodical scientific production of research productivity fellows (PQ [1]) from CNPq [2] in Information Science (IS) in

Brazil between 2001 and 2021. Secondary objectives are: to identify the authors of the sociological currents focused on knowledge, science, and scientific knowledge present in the periodical scientific production in the field of information science in Brazil; to highlight similarities or differences between them; to diachronically analyze the presence of the authors of the three sociological branches in the periodical production of the PQ fellows; and to identify the coupling of authors from these three branches.

The hypothesis of this study allows for dialogue between sociological studies on knowledge, science, and scientific knowledge and the Brazilian production of Information Science PQ fellows. This dialogue was supported using the approaches suggested by Hjørland (2002) for domain analysis in information science: the epistemological and critical studies and the bibliometric studies, with emphasis on the analysis of author coupling.

Given the potential of this analytical conjunction, which produces a representative approximation of the presence of authors from the aforementioned fields of sociology, this research assumes the possibility of understanding scientific production as the set of publications originating from research in different scientific fields and domains (Macias-Chapula 1998) and the recognition, as Damus and Acuña (2019) suggest, of relevant aspects of a domain related to IS. In this sense, the study of communication, both internal (inter-domain) and external (cross-domains), can be inspired by different types of sociological theory, including the founding currents of sociological studies on science and scientific knowledge.

Another assumption of this research stems from the need for a percussive analysis of the conjunctural and historical elements of scientific research present in the changes and contradictions of its context, both in its internal organization and in its applications and relationships between domains. The special interest in conducting this study is underlined by Cronin's (2008) challenge regarding the absorption of sociological thought by IS, with special emphasis on Bourdieu, Castells, Giddens, and Latour, bringing forth interest for the recognition of the issues and aspects related to this approach, such as its roots.

The complexity of seeking to comprehend the various schools of thought and theoretical currents focused on knowledge and science, with their specific characteristics, is amplified by social contradictions, which pose challenges to the historical awareness of the knowledge acquired

by their respective researchers. In its relationship with the actions and modes of production in society, this knowledge is permeated by the political dimension of the construction of realities and social relations.

Thus, if on the one hand the lack of socioeconomic conditions or political will can obstruct activities or processes of scientific research, on the other hand these same factors, allied to the imperatives of production in a certain socio-political context, allow the mobilization of scientific and technological resources to constantly grow the scientific production, either in general or specifically targeted to a certain area. In this case, the science produced may become a privileged instrument of legitimation of power, as it is mobilized as a productive force. In this sense, scientific information is, at the same time, a primary matter and a product of science, capable of playing an ideological role to the extent that its objectivity and neutrality may contribute to legitimize power. If hegemonic power is presented as rational, as it allows the improvement of productive forces due to the systematic use of scientific and technical knowledge, then it is important to unveil the forms of legitimization and reinforcement of this power. Under Bourdieusian concepts, translated and interpreted in the context of the field of knowledge (Bourdieu 1983), these forms are objectively manifested in both the substantive choices and the methodological options of researchers participating in a given field of knowledge and practice.

Referring to the "[…] two fundamental positions in the face of social knowledge, within contemporary rationalism", Paulo Netto (1989 p. 143) considers the former as capable of analyzing the phenomena from their concrete expression. From this point of view, theoretical research precedes the systematization of empirical material (selection, organization, classification, typification, and categorization). This is what theory is built upon, producing an ideal simile to highlight the dynamizing relations of reality. By turning to concrete objects, seeking to elucidate the also concrete relations of their elements in their specific contexts, this research reiterates the proximity with totality. Theory is thus understood as "[…] a peculiar mode of knowledge" (Marx 1982 p. 15) because theoretical knowledge is independent of the researcher's wishes, aspirations, and representations.

In this way, considerations about IS, the domains of knowledge, and practices related to the former are reconciled, because from the study of these domains, or the communities

participating in the social division of labor (Hjørland, and Albrechtsen 1995), the category of totality, prior to being epistemological, reveals itself as an ontological one, constitutive of the very nature of the social being.

In order to unveil elements, present in the dialogue between sociological studies on knowledge, science, and scientific knowledge and the Brazilian production of IS PQ fellows, this article is composed of this introduction; a second section, concerning the main sociological theories on science from the 20th century on, as well as the DA; and the third and fourth sections, focused on the methodological procedures and results and analysis, respectively. Finally, we close the article with some final considerations.

2 Main sociological theories on science from the 20th century and domain analysis

The sociology of knowledge, the first systematized analysis of science supported by sociology, arose in the beginning of the 20th century with, according to Schwartzman (1984), origins in Marxism. This conception is shared by Elias (2008 p. 515), for whom "[…] the problem of the relationship between 'consciousness' and 'society' received its first paradigmatic formulation within the theoretical structuring of Marx and Engels". Individuals, as they build webs of interdependence, form configurations that are diverse in nature, such as families, villages, cities, states, and nations. The concept of configuration can be applied wherever connections and webs of human interdependence are formed, either in relatively small groups or in larger clusters.

When systematizing the theoretical and methodological dimensions of the sociology of knowledge, Mannheim (1976) posited knowledge not only as a result of theoretical consciousness but rather in its broader dimension, recognizing social reality as the primary sphere of the constitution of thought and, therefore, of all socially conditioned human activity (Fetz, et al. 2011). Mannheim is a key reference point for the understanding of science through the Marxist framework of sociology, albeit he was part of a non-Marxist current with Weberian elements concerning the issue of knowledge as a reflection of the social structure, in a way that was also distinct from Durkheim and his followers. He epistemologically distinguishes between the knowledge of the well-developed sciences – such as physics and mathematics – and socio-historical knowledge,

placing the former in a "sociological exclusion zone" (Iranzo Amatriaín, and Blanco Merlo 1999). However, this distinction is based on the notion of real and ideal factors and, according to Mannheim (1976), natural science should not be conceived as a subject of the sociology of knowledge. Nevertheless, his works do not explicitly argue in favor of a thesis on this restriction (Vessuri 1994).

The sociology of science focuses on the relationship between science and society, placing the former in its necessary relationship with the external events that surround it and which, to a large extent, condition its discoveries. Although it can be conceived as a branch of the sociology of knowledge, the first and most influential theoretical tradition of the sociology of science was established by Merton (1970) in his works from 1942 onwards. Robert King Merton and Thomas S. Kuhn turned to the external constraints of the rational realm of scientific production to understand the configuration of the logic of scientific discovery, as well as the validation of the products of science.

The sociology of scientific knowledge, in turn, emerged between the late 1960s and early 1970s in the United Kingdom, France, Germany, and the United States. Its leading theorists include Barry Barnes, David Bloor, Sal Restivo, Randall Collins, Gaston Bachelard, Harry Collins, Paul Feyerabend, Steve Fuller, Thomas Kuhn, Martin Kusch, Bruno Latour, Mike Mulkay, Derek J. de Solla Price, Lucy Suchman, and Anselm Strauss. It is best characterized by the critique of Merton's thought; by the radicalization of Kuhn's historical approach; by the dissemination of the theoretical-epistemological approaches that guide the field; and by the relationship between knowledge and its social context.

While acknowledging the possibility of inaccuracies, sociologists of scientific knowledge have studied the development of the field, looking for points of contingency or interpretative flexibility that are related to multiple political, historical, cultural, or economic factors in the theoretical or empirical configurations to be studied. A researcher's goal is to explain why one interpretation has the potential to succeed rather than another due to social and historical circumstances.

As a summary of the abovementioned notions, we highlight three fields within sociological theories: the sociology of knowledge, the sociology of science, and the sociology of scientific

knowledge (Mattedi 2006; Fetz, et al. 2011). This pragmatic distinction will be used in lieu of other possibilities for this analytical study of a specific domain of knowledge.

Restating the importance of the concept of "domain", which has been configured in the writings of several historians, sociologists, and anthropologists as a "[…] resource to theoretically constitute objects of investigation", this study relies on the structurism thus named by Lloyd (1995 p. 25) as an explanatory model of analysis.

Lloyd's (1995 p. 38) reflection on the nature of history, seen from the angle of social structures, feeds on a wide range of references from Richard Rorty, Michel Foucault, and Jacques Derrida, reinforcing the need to "[…] understand the expies in philosophy of history and the social sciences, as well as texts by historians and sociologists from the last two centuries". Aligned with the complex historical realism modeled mainly by Clifford Geertz, Ernest Gellner, Emmanuel Le Roy Ladurie, and Michael Mann, the author essentially rails against the relativism of authors such as Rorty, Foucault, and Derrida, reinforcing the need to "[…] understand the explanations and employment of frameworks which include methodological and philosophical assumptions" (Lloyd 1995 p. 38) because such sets of ideas and beliefs about the world and the way we perceive it belong to the realms of knowledge; they are products of history, theory and scientific discoveries over the centuries, in new paradigms, including the information paradigm, which deals with fragmentation and dispersion.

These "domains of scientific knowledge", products of the history of methodology, theory, and scientific discovery in a constant process of refinement, are also products of processes of constitution and unification, which must be recovered in order to produce a scientific explanation. For Lloyd (1995), science is a worldview different from others because of its explanatory power and its ability to critically examine all other frameworks as well as reflexively examine itself. This process of reordering and reconstructing science within the same domain, from the perspective of philosophical and sociological realism, is one of the foundations of methodological structurism, firmly opposed to relativism, postmodernism, pragmatism, and common-sense historiography.

The scientific domain of IS has been discussed having interdisciplinarity as a factor of complexity for its delimitation, construction of its own terminology and recognition of its domain before the scientific community. Understanding its domain is further supported by the awareness

of the scientific literature in the field. According to Lloyd (1995 p. 38), "[…] the analysis of a scientific construct allows better understanding of the explanations and employment of frameworks that comprise methodological and philosophical assumptions". From this theoretical foundation, it is possible to incorporate knowledge in favor of understanding the history and accumulated findings of the science under analysis. The concern of this study is therefore justified in exploring the formal evolution of the IS literature to explore the relationships in its constitution.

We start from the evidence that the vast scientific area whose object is information has been marked by the debate about the delimitations of its correlated fields – archivology, librarianship, documentation, information management and museology –, as well as its bordering fields – particularly information and communication technologies (ICTs), administration, economics, education, psychology and sociology – which, either by their disciplinary contents or by their relations and influences, interact in the transforming action of the research process. In this way, the influx of contextual issues is highlighted as a contribution to epistemological studies.

The proposals for carrying out academic research, for example, suggest the search for a new intelligibility for human action and a new explanation of the general context, starting from the analysis of singular experiences in certain informational contexts. This type of analysis allows us to understand subjects and social structures in their interaction with structuring power. "In this model, social structures are the emergent set of rules, roles, relations, and meanings within which people are born, and which organize their thoughts and actions, and by which it is in turn reproduced and transformed […]" (Lloyd 1995 p. 60).

Information science was established in 1962, in the United States, with the objective of attending to the growing specialized information after the war, which resulted, in part, from the confrontation between the great world powers, as well as the accelerated development of information technologies. From 1945 to the early 1970s, when quantitative approaches dominated research and investigations in the different fields of science, IS was characterized by the development of concepts with positivist, empiricist, and pragmatic characteristics. This "trend" of numbers, in force until the 1970s, gradually gave way to the "[…] phenomenological and interpretive hegemony, and the cognitivist perspective began to dominate informational spaces" (Oliveira 2018 p. 48).

The omnipresence of the cognitivists began to be questioned as early as the 1990s, due to the absence or even exclusion of the cultural and social environments in which the individuals participated. In the various scientific theories, a strong tendency to ground and incorporate a broader social, cultural, and historical perspective could be seen in the investigations. In the last years of the 20th century, new theoretical currents in IS were characterized, fundamentally, by the relevance and visibility gained by the social, the cultural, and the contextual.

In 1995, Birger Hjørland and Hanne Albrechtsen developed a social epistemological paradigm called the Domain Analysis paradigm, whose main emphasis is on the relationship between different fields of knowledge and discourse communities (Hjørland, and Albrechtsen 1995). Standing out as one of the main theoretical bases in IS, DA was in fact first utilized in 1980 in the field of computer science by Neighbors (Hjørland 2002). Within IS and from a sociological perspective, DA focuses on the context rather than the individual, as it was done in the cognitivist perspective (Hjørland, and Albrechtsen 1995).

From the DA perspective, the object of IS is the relationships among discourses, knowledge areas, and documents concerning the many viewpoints of different user communities (Hjørland 2002). It results in an integration of the individualistic and isolationist approaches of the cognitive paradigm in a social context where different communities develop their selection and relevance criteria. Casting a look at the history of science, the concept of domain was used by Lloyd (1995) as a resource to constitute the theoretical basis of research objects. Thus, the concept of "scientific domain" precedes the modality of study that is now called Domain Analysis.

According to Lloyd (1995 p. 51), "[…] what makes scientific discourse true and sustainable is the combination of its rationality (organized reasoning) and its orientation to the world and possibility of practical application." Lloyd (1995) argues that the characterization of a domain depends on the constituent community, which means that different groups may have different ideas of what a "domain" would be. Moreover, knowing different approaches is important for solving different problems. Such conceptions provide ways to better understand a scientific domain in its context.

The concept of domain involves the understanding of cultural, anthropological, historical, and social aspects, and is both complex to understand and subject to controversy. It can be

understood as a scientific discipline, a field of scientific knowledge in its different specialties, a corpus of literature on a given subject, or a group of people working in an organization, contemplating the study of a discourse community and the role it plays in science (Hjørland, and Albrechtsen 1995; Mai 2005).

Hjørland and Albrechtsen (1995 p. 400) define domains as "[…] communities of thought or discourse, which are parts of society's division of labor", hence their social and cultural foundations. From this research's perspective, a domain is an area of knowledge, activity, and interest in which a certain knowledge is delimited, with professionals or groups versed in thought and language. Domain analysis seeks an integration of the individual, transcending cognitivist approaches and reaching the social context of the communities in which individuals are inserted. As a result, the concepts of information acquire meaning in the sharing between different communities and their members.

In this study, we employ two "approaches" to DA, as proposed by Hjørland (2002): epistemological and bibliometric studies. Epistemological and critical studies propose the organization of paradigms and different approaches to knowledge according to basic assumptions on knowledge and reality. Epistemology is understood as the interpretation of all scientific experience produced and collected by researchers, such as the explicit or implicit assumptions that permeate or underlie their research, translated into the research paradigms, which leads to the full understanding of the research object. For instance, the proposal of DA was established as a possibility with a strong individualistic quality and suitable to replace the cognitivist proposals that had prevailed up until then.

The bibliometric studies, both in terms of their development and application in the different fields of knowledge – a subject proper to bibliometrists –, have constituted a theoretical and methodological reference, especially since the advent of ICTs, enabling the treatment of large amounts of data. As a combination of these research procedures, this approach is used to map science and visualize the different scientific fields in terms of researchers, institutions, or countries, revealing dominant theoretical currents either through studies of scientific collaborations or analysis of citations and co-citations. From this research's perspective, every bibliometric study

must contextualize and integrate more than one approach in order to combine them, under the risk of retroceding in the history and epistemology of science.

Among the analytical possibilities of the metric studies of information, citation analysis has played an important part in understanding authors' impact and visibility and has served various sorts of studies. Relational citation analysis is used to map authorial, thematic, theoretical, or methodological similarities between articles or authors. It can connect different units of analysis, such as authors, documents, journals, and countries, among others. There are two main methods of relational citation analysis: Author Cocitation Analysis (ACA) and Author Bibliographic Coupling (ABC), that differ from each other despite some similarities (Marshakova 1981). Bibliographic coupling connects articles that cite the same documents, while the co-citation method connects articles cited by the same document. Therefore, they work in opposite and complementary ways.

The Coupling Method assumes that if two articles reference the same document, they have theoretical or methodological similarities (Kessler 1963). Thus, if two articles use a common reference, they are considered bibliographically coupled (Egghe, and Rousseau 2002), since the structures of their founding or methodological ideas converge.

In 2008, Zhao and Strotmann, inspired by Kessler's (1963) ideas about bibliographic coupling, proposed the Author Bibliographic Coupling Analysis (ABCA) to analyze the similarity between two reference lists of different authors, much like Kessler's method. Figure 1 represents the concept of author bibliographic coupling.

Figure 1 - Representation of Authors Bibliographic Coupling
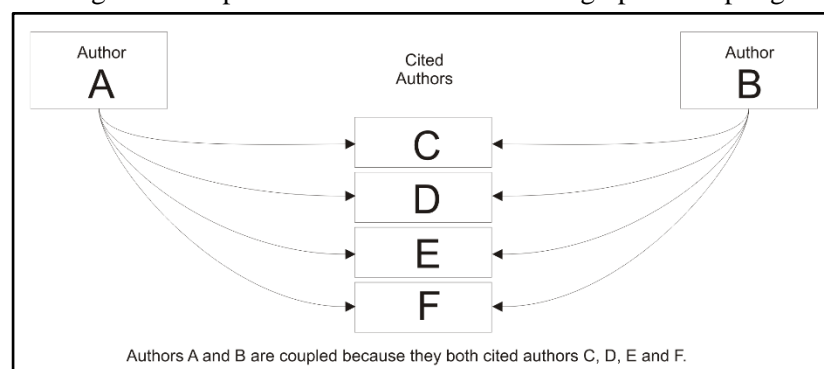
Source: adapted by the authors from Garfield (2001).

Authors A and B cite the following references in common: author C, author D, author E, and author F. Therefore, authors A and B are considered bibliographically coupled.

Zhao and Strotmann (2008) use the frequency of ABC between two citing authors using their common references. In other words, the greater the number of references in common, the greater the frequency of coupling, which implies that their similarities are relevant within a given scientific domain.

3 Methodological Trajectory

The methodological procedures were based on the development phases of the corpus of analysis, when the cited authors were identified a priori, considering the aspects of sociology of knowledge, sociology of science, and sociology of scientific knowledge, and taking into account both the theoretical repertoire of scientific literature and the previous knowledge of the authors of this study, as a result of their teaching and research activities in IS Graduate programs.

Next, we identified the presence of the authors cited as references in the scientific production registered at Brapci [3] by searching the full-text for the last name of the author in Table 1, for example, "Bourdieu, P". Studies published in Brazilian IS journals from 1972 onwards and that were not written by at least one author with an IS productivity scholarship (PQ) were removed from the list.

In the initial search, 550 papers were retrieved and 15,192 references were collected, corresponding to the researchers' academic productions since 1972 – the period covered by the Brapci database. The references were grouped and sorted alphabetically. A manual search was then conducted with the list of references, using the term "sociolog*" to identify other authors of the field that were not considered a priori. For each incidence, the relevance of the work and author to the theme of this study was verified – this being the inclusion criteria for the list of authors in Table 1. At this stage, 14 authors that were not listed a priori were identified and included in the analysis.

The search on Brapci was repeated with the newly identified authors, adding them to the PQs' lists of bibliography and used references. In total, 1,686 documents were identified and, after

removing replicates or those with minor relevance, 766 documents ended up constituting the corpus of analysis.

To perform the bibliographic coupling analysis, we identified all the documents in which the authors in Table 1 (also named referents) were cited, based on the concepts of the three aforementioned fields and in a mutually exclusive way.

Table 1 - Categorization of the fields and list of referenced authors

SOCIOLOGY OF KNOWLEDGE		
Friedrich Nietzsche	Karl Popper	
Friedrich Engels	Kurt Heinrich Wolff	
Karl Mannheim	Max Weber	
Karl Marx	Simon Schwartzman	
SOCIOLOGY OF SCIENCE		
Robert Merton	Thomas S. Kuhn	
SOCIOLOGY OF SCIENTIFIC KNOWLEDGE		
Anselm Strauss	Gaston Bachelard	Pierre Bourdieu
Anthony Giddens	Harold Garfinkel	Randall Collins
Ariel Colonomos	Harry Collins	Richard Harvey Brown
Blaise Cronin	Karin Knorr-Cetina	Steve Fuller
Bruno Latour	Manuel Castells	Steve Woolgar
Christopher Lloyd	Martin Kusch	Thomas Luckmann
David Bloor	Mike Mulkay (Michael Joseph Mulkay)	Trevor Pinch
Derek de Solla Price	Paul Feyerabend	Wiebe Bijker
Diana Crane	Peter Ludwig Berger	

Source: the authors (2021).

The significant number of authors related to sociology of scientific knowledge is attributed to the comprehensiveness of the term derived from studies of the Strong Program of Sociology of Knowledge, also named New Sociology of Science (Fetz, et al. 2011). However, the term sociology of science continues to be used to represent the changes and continuities in sociological conceptions of scientific activity, from its classical origin to contemporary studies.

Using R software, we built a bubble graphic to represent the year by year evolution of the citations of sociology authors by the PQs from 1972 to 2020. The figure chronologically shows in which year the concepts of sociology began to permeate the foundations of IS and which sociologists were the most influential in this production.

Next, a coupling graphic of the PQ authors – with citations to the referents of sociology, the position of the 98 PQs and their respective citations to the authors of the three fields of

sociology – was built with Canvas, in JavaScript, to allow the visualization and concise analysis of the citing and cited researchers (Fig. 3).

To complement the analytical procedure, we also built the matrix (citing x cited) with the list of PQ researchers and cited authors, resulting in a 98x36 matrix, considering that, of the 104 PQ researchers, six of them did not cite sociological studies. We used the adjacency matrix to verify the most cited sociologists in each field and apply them in the author coupling analysis.

Finally, a network of sociology researchers was built to describe the relationships between them and the PQs most coupled by them, using the Pajek software to perform the respective analysis.

In order to understand the characteristics and relationships in the dynamics of scientific production, the analytical procedures helped to identify not only the singularity of specific citation cases but also, as Bourdieu (1996) claims, the particularities of collective histories.

4 Results and analysis

Based on the PQ researchers' citations, we created Figure 2 to chronologically show the number of times the referent authors were cited. The citations were organized by year, considering their evolution due to the expressive number of PQs. The circles in Figure 2 show areas proportional to the quantity of citations made to the referent authors.

Of particular note is the first citation made to the British sociologist Harry Collins (from the sociology of science field) in 1977. His presence in the history of sociological studies of science is marked by the introduction of the "three waves", the first referring to the time of Merton and philosophers such as Popper, for whom scientific knowledge consisted of a superior knowledge to be developed in democratic societies. The second wave would have started in the early 1970s, particularly influenced by Kuhn and the philosophy of the second Wittgenstein. To Collins, "[…] the problem in this period would be 'understanding the value of science' because of the absence of a 'special epistemological justification'" (Collins, and Evans 2002 p. 19). Thus, the second wave leveled science to other types of knowledge in an epistemological way, deconstructing the naive vision held by the first wave. On the other hand, it brought to light an important set of questions:

it is practically impossible to imagine a super-inhabited world like ours in which science does not exist.

The third wave aims precisely at overcoming this problem. It admits that science has no epistemological prestige, yet it argues that "[…] the opinions of those who 'know what they are talking about' are worth more than the opinions of those who do not" (Collins 2015 p. 20). In other words, Collins and Evans (2002) defend expertise as the founding principle of the third wave of the social studies of science and technology, that is, the belief that a decision made by an expert is likely to be the most appropriate one, even though mistakes can be made.

Beginning in the 1989s, citations to Kuhn, Popper, and Cronin start to appear diffusely. As from 1991, citations to sociology scholars increased in all three fields. At the beginning of the 21st century, PQ researchers, influenced by the new sociocultural paradigms of IS, started to actively cite the seminal authors of sociology in their theoretical foundations.

Figure 2 - Evolution of citations of sociology authors by CNPq's productivity fellows in Information Science in Brazil from 1972 to 2020.
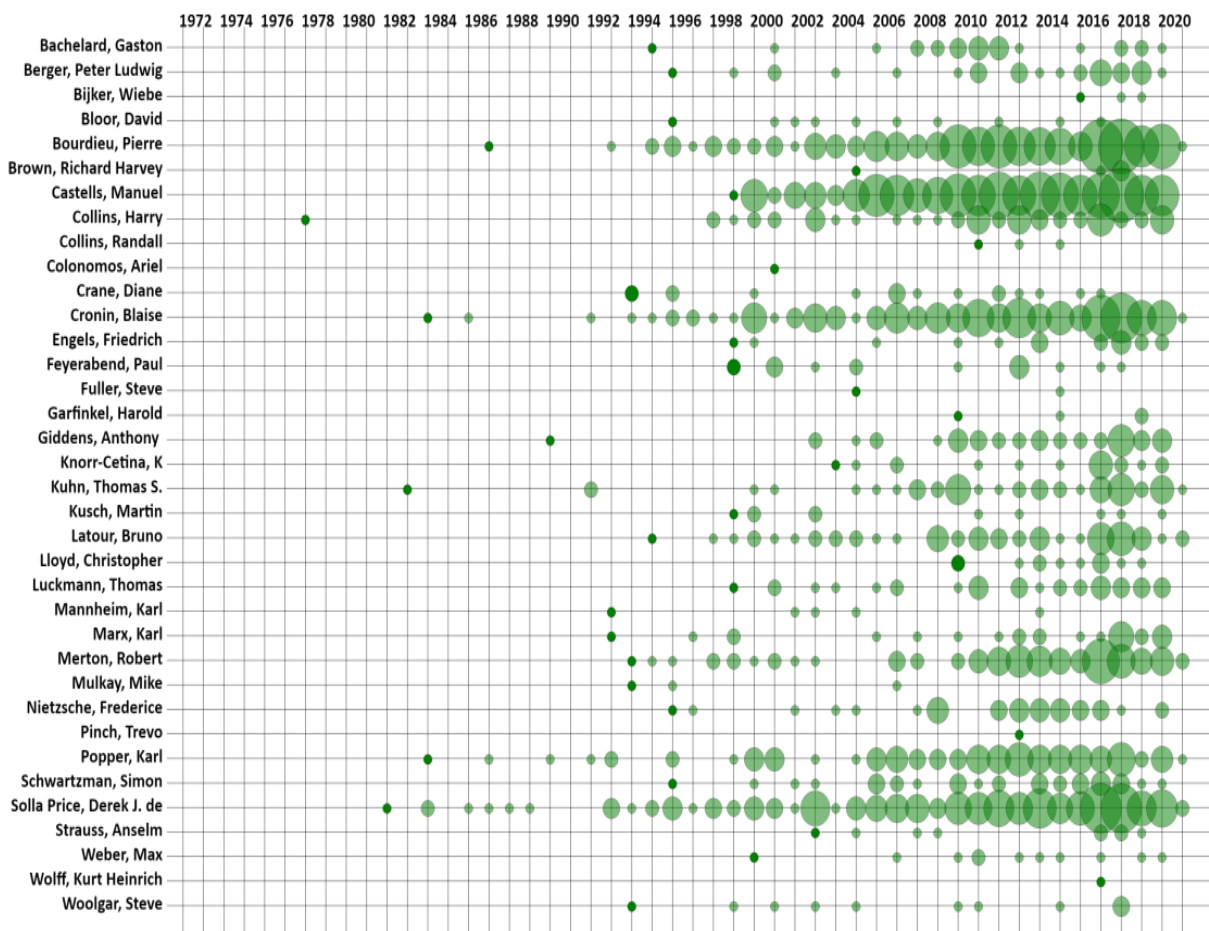
Source: Developed by the authors (2021) using the bubble graphic built with the R software.

Figure 2 shows the authors Merton and Popper (sociology of science and knowledge, respectively), and Latour and Bourdieu (sociology of scientific knowledge) with great prominence since the 1990s. All of them are increasingly cited over the years, forming a *continuum* of large circular areas. Other outstanding authors are Cronin (sociology of scientific knowledge), cited since 1983, and Castells (sociology of scientific knowledge), the most cited among all the referents.

It is worth noting Cronin's (2008) widely cited records on the results of a research on sociologists imported by IS, such as Bourdieu, Castells, Giddens, and Latour, as an indication of receptivity to sociological thought, although it is not possible to specify when this convergence

started, since "[…] it is not clear that there was in fact a historical moment when the field became, in any way, sociologically enlightened, or that it had changed gears paradigmatically as a result of concentrated exposure to sociological ideas" (Cronin 2008 p. 473).

In Brazil, this "enlightenment" can be more easily perceived when we follow the production in the field of IS diachronically, especially due to the conditions granted by Brapci to this analysis, which contributed to a pragmatic construction to recognize the progress of scientific communication with its peculiarities and gnoseological and institutional frameworks.

Another author that stands out is Solla Price, whose contribution to IS itself, and more specifically to Bibliometric studies, is present in the PQs citations since 1981 and up until the last years of the analyzed period.

In this trajectory, curiously enough, Karl Marx, Émile Durkheim, and Max Weber, considered to be the founders of sociology, were not particularly favored as one would expect. Marx had 32 citations and Weber eight, while Durkheim was not referenced at all. The first citation to Marx was made in 1992, but the years 2017 and 2019 showed the highest number of records of his name (Figure 2). The inexpressive presence of Marx and Marxist sociologists is worth mentioning as a sign of the field's conservatism, a problem that goes back to its origins, as librarianship and IS in Brazil grew in the midst of a repressive state. The structure for Brazilian research was built and based on the American model, a post-war hegemonic model of development that influenced and still dominates the scientific policies of peripheral countries. At the time, technicist-oriented higher education institutions were created in Brazil following the United States standard. Foreign organizations, especially from the US, had a strong influence on the budget allocations for teaching and research, which had a negative impact on higher education in Brazil, compromising the notion of universities (Bufrem 1997).

Figure 3 shows how the 98 researchers are coupled by referents from the three sociological fields. In this figure, the authors in blue circles (8) are part of the sociology of knowledge referential, while the ones in green (2) are representatives of sociology of science and the ones in red of sociology of scientific knowledge (26). The two lateral semicircles represent the 98 PQ researchers who cite the listed sociologists.

Figure 3 - Coupling of PQ authors and citations to sociology authors.
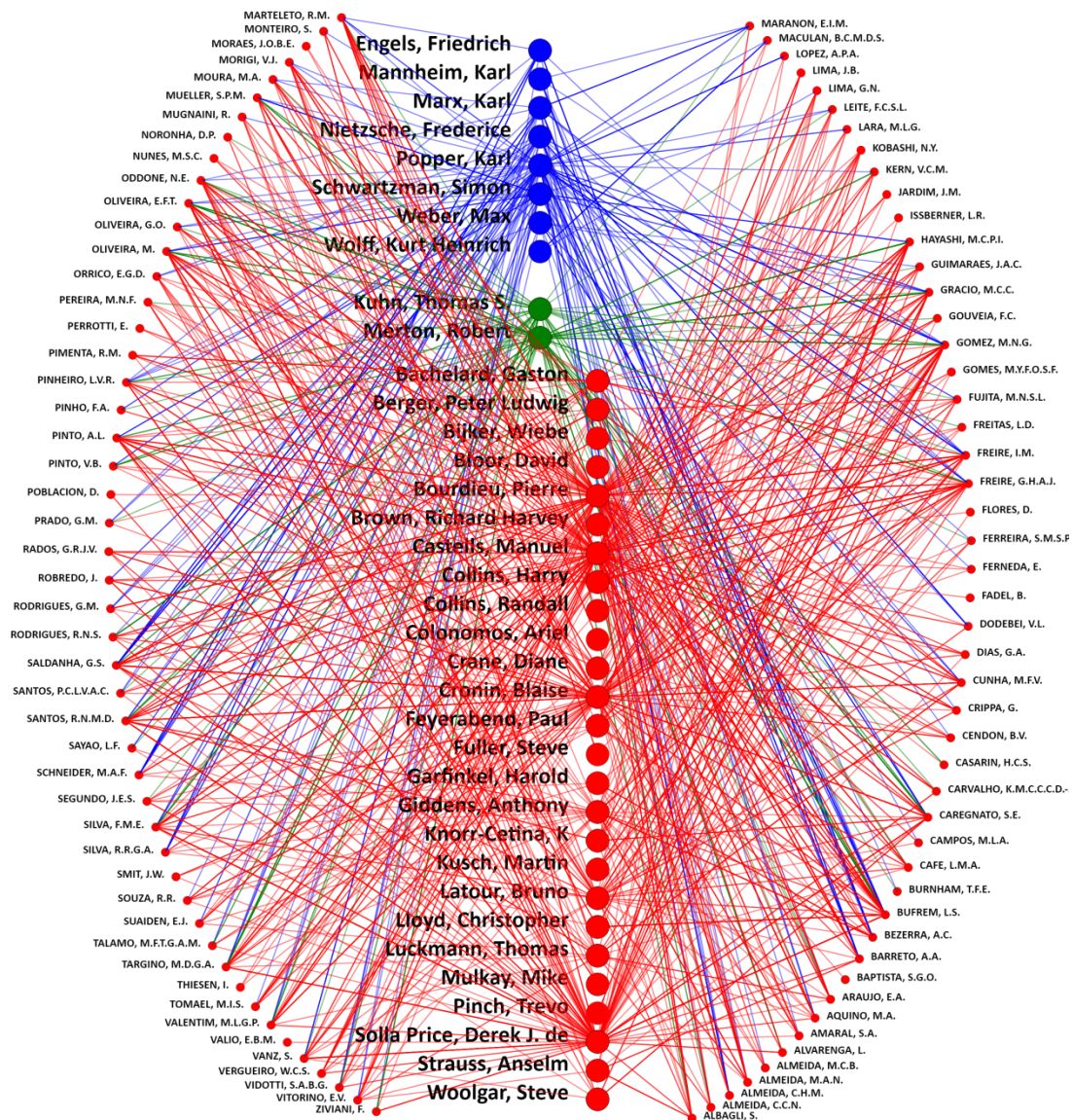
Source: Research data developed by the authors (2021) using the *Canvas* application in Javascript.

We can see that, although the sociology of knowledge (in blue) has come from Marxism, the group also includes authors such as Mannheim, Wolff, Weber, Nietzsche, and Popper. This plurality is explained by Mannheim's supporting role for the understanding of science under the Marxist framework of sociology and, given its social dimension, for its recognition in the constitution of scientific thought. However, the analyzed corpus shows a predominance of references that are irrelevant or opposed to Marxist categories and principles in view of the reality

observed by each of these productions. This characteristic has been addressed by authors such as Araújo (2014), for example, who discussed the fields of archival science, librarianship, museology, and information science, as well as their technical and operational traditions. Historical evidences support this position, including the history of library professionals' training in Brazil, which is tied to an elite project since its conception. In this sense, Souza (1990) criticizes the curriculum content of the late 20th century focused on human resources' demands, showing that they trained a great number of good collection curators with little ability to correspond to the framework of economic and social development experienced by the country since the 1940s. The historical silencing of the social perspective in IS research also stems from the political situation of the Brazilian civil-military dictatorship, when the Brazilian Institute of Information in Science and Technology (IBICT) created the first master's program in IS. The country had restricted its social and philosophical expressions and narrowed the spaces for reflection, more specifically the higher education institutions, in which research started to emphasize methodological formalities and themes endorsed by institutional control (Bufrem 1996).

Weber has been a reference for IS due to his reflections on the nature, problem, and extent of knowledge of the social reality, especially with his book Basic Concepts in Sociology, in which he approaches the totality through the search for the "[…] interpretative understanding of social action in order thereby to arrive at a causal explanation of its course and effects" (Weber 2008 p. 11). Sociology of knowledge was effectively disseminated through Wolff's translations of Georg Simmel and Karl Mannheim into English. Nietzsche and Popper also comprise this group, further diversifying its structure. The former – by denying any truth as an absolute and universal criterion – affirms the subject before their own freedom and responsibility in a struggle for what he calls "to know", that is, "[…] to schematize—to impose upon chaos as much regularity and as many forms as our practical needs require" (Nietzsche, quoted in Heidegger 2007 p. 431). Popper, in turn, is a critical realist, standing out for his defense of the existence of a material world, "[…] independent of experience" (Magee 1979 p. 54), and for proposing the criterion of falsifiability.

As for Merton and Kuhn (in green), they contributed greatly by linking different theoretical assumptions that generated previous systematized knowledge, providing, especially Merton, support for the development of the sociology of science.

Regarding the other referents, 26 representatives from the sociology of scientific knowledge were cited by the PQs. The highest incidence of authors relates to the thematic and methodological scope of this field since, in order to carry out their studies, its representatives focus on the identification of elements of contingency or interpretive flexibility, which are related to sociopolitical, economic, historical, and cultural factors. However, in addition to interpretations resulting from social and historical circumstances, the constraints of the scientific field of occurrence must also be considered.

According to the network of coupling incidence and the matrix (citing x cited), Castells is the most cited author in sociology of scientific knowledge, followed by Bourdieu. Several authors are coupled to them, which also occurs with Solla Price, to whom is attributed the effort of establishing citation standards in the 1960s, as well as the goal of developing a science of science (Collins 1983), while Cronin (2008) turns to the social perspective of IS and its Librarianship and Documentation origins. The four authors have high mutual incidence. In a study on IS receptivity to sociology, Cronin (2008) also highlights Bourdieu and Castells, among authors widely cited in the literature of this field, although he does not inform the "[…] historical moment at which the field became somehow sociologically enlightened or shifted gears paradigmatically as a result of concentrated exposure to insights from mainstream sociology" (Cronin 2008 p. 473).

Therefore, Castells – with his studies on the network society –, Bourdieu – who put the social and cultural capital on the agenda –, Popper, Merton, Solla Price, and Cronin are the theoretical references most cited by researchers focused on issues related to sociology in IS studies, constituting an interdomain context to be more extensively explored in future coupling studies.

We carried out a coupling analysis of the PQ authors who cited at least one of the three fields. Popper stands out in the sociology of knowledge, cited by 48 PQ researchers (107 times), among them Bufrem (11), Saldanha (10), Almeida C.H.M. (8), Gomes (8), Freire I. (7), and other citing authors with less frequency. However, even though Popper couples these five researchers with different frequencies, their approaches to the referent author do not always coincide. Popper, for example, had the works "Conjectures and Refutations" and "The Logic of Scientific Discovery" cited in studies with different focuses: philosophy of science and characteristics of the scientific method.

Regarding sociology of science, Merton stands out for the frequency of citations, with a total of 39 occurrences. Hayashi cited him 12 times, followed by Saldanha and Grácio (10 times each), Bufrem (8 times), and Oliveira E.F.T. and Caregnato (7 times each). Thus, from the data in Figure 2, we conclude that the researchers Hayashi, Grácio, Saldanha, Bufrem, Oliveira E.F.T., and Caregnato are coupled by citations to Merton. The frequency of citations to him ranges from seven to 12. In this case, Bufrem references the two authors from sociology of knowledge and sociology of science, namely, Popper and Merton. This group of citing authors is especially interested in knowledge studies, which began in the 1940s and consolidated sociology of science as a discipline. Its purpose would be to "objectively" establish the correspondence between knowledge, social factors, and culture (Merton 1985). Questions regarding these issues are discussed more deeply by the PQs coupled by Popper and complemented by the debate on relativism. Popper's critical rationalism – as well as the philosophy of Wittgenstein, whose post-positivist perspective called into question the concept of irrefutable and universal truths – gained IS supporters regarding the impossibility of an absolute knowledge. As for scientific knowledge, Popper laid the foundations of the hypothetico-deductive method and the criterion of falsifiability in his work "Conjectural knowledge: my solution to the problem of induction". He assumes a critical realist position by believing that "[…] a material world exists, independent of experience" (Popper 1975 p. 536). Karl Popper is regarded as a member of the Vienna Circle, but he was actually a harsh critic of logical positivism. He is characterized by his methodological stance "[…] of stating one's problem clearly and of examining its various proposed solutions critically" (Popper 1975 p. 536), the same way he relates the scientific attitude towards problems to a rational and critical approach.

In the sociology of scientific knowledge, Castells, Bourdieu, Solla Price, and Cronin stand out with 332, 293, 237, and 208 citations, respectively.

Solla Price was cited by Bufrem (26 times), Pinto (21 times), Oliveira, E.F.T. (17 times), Hayashi (13 times), Grácio (13 times), Silva F.M.E, (11 times), Caregnato (11 times), Santos, L. N.M. (10 times), Pinheiro L.M.E. (9 times), and Targino and Vanz (7 times each). Thus, we conclude that Bufrem, Pinto, Oliveira E.F.T., Hayashi, Grácio, Silva, Caregnato, Santos L.N.M., Pinheiro L.M.E., Targino and Vanz are coupled by this author, according to the data in Figure 3.

The frequency of citations to Price ranges from seven to 26, which means that 11 PQ researchers are coupled by him. The sociologist contributed to IS with both the fundamentals of sociology and the citation analysis procedures, with consequences to the research front. He is credited with the first explicit effort, still in the 1960s, to identify citation patterns. By proposing to develop a science of science (Collins, 1983), that is, to replace the conventional practice of the history of science with other models, Price realized the possibility of interaction between citation analysis and sociology of science, being responsible for advancing measuring techniques, which have been used and improved.

Bourdieu, the second most cited referent, was referenced by Bufrem (43 times), Marteleto (17 times), Saldanha (12 times), Freire, I. (12 times), Caregnato (12 times), Barreto (10 times), Silva, F.M.E. (9 times), Oliveira, M. (9 times), Hayashi (8 times), Oliveira E.F.T. (8 times), and Oddone, Rodrigues and Gomez M.M.G. (7 times each). A total of 13 researchers are coupled by Bourdieu, which shows the sociologist's great significance in the field, especially in the last 20 years, with a citation frequency ranging between 7 and 43 citations in the period analyzed. Regarding their relations with other sociology fields, most of the citing authors articulate their research to notions such as scientific field and autonomy.

Totaling 208 citations, Cronin was referenced by Saldanha (18 times), Oliveira M. (18 times), Caregnato (12 times), Cunha M.F.V. (9 times), Santos R.N.M. (9 times), Freire G.H. (8 times), Grácio (8 times), and Freire (7 times). Considering the interval analyzed, these eight researchers are coupled by Cronin in frequencies that range between 7 to 18 citations.

Crippa, Morigi, Tomael, and Targino cited the author seven times each. Therefore, these ten authors are coupled by Castells in a frequency ranging from 7 to 47 citations. He is considered one of the great theorists of the "knowledge society" and, in 1980, he left Marxist studies aside to focus on the role of new technologies in society, especially in economy, developing notions on informational capitalism. Thinking from the perspective of a network society, Castells created structures grounded on the political, cultural, social, and economic fields for the informational flow, giving rise to a more conscious perception. He has studies both on human intellectual capacities, which were improved by the transformations of a network society, and the optimistic perceptions of citing authors, which are related to the inevitable advent of the Internet-based digital

society (Castells 1998). This author couples researchers with thematic but also epistemological and methodological affinities, although the trends are very diversified, occupying even antagonistic positions regarding the expectations of the network society.

From the analysis of the IS PQ researchers, regarding the most cited sociologists of the three perspectives studied, we highlight that the researchers Bufrem and Saldanha are coupled by Popper (sociology of knowledge), Merton (sociology of science), and Bourdieu (sociology of scientific knowledge). Thus, the frequency of bibliographic coupling between the two researchers is equal to 3, which means Popper, Merton, and Bourdieu are coupled by Bufrem and Saldanha, and these two are considered bibliographically coupled.

Hayashi, Grácio, Oliveira E.F.T., Bufrem, and Caregnato S.E. are also coupled by Merton, from sociology of science, and Solla Price, from sociology of scientific knowledge. The sociology of science author most cited by different IS researchers was Bourdieu: Bufrem, Saldanha, Marteleto, Gomes, Freire I., Hayashi, Oliveira E.F.T., Caregnato, Barreto, Oddone, Oliveira, M., Rodrigues, and Silva F.M.E. have cited the sociologist.

In order to better visualize the relations between the sociology researchers cited by the PQ fellows, we present their relation network.

Figure 4 - Relation network of the sociologists coupling the CNPq's productivity fellows in Information Science in Brazil
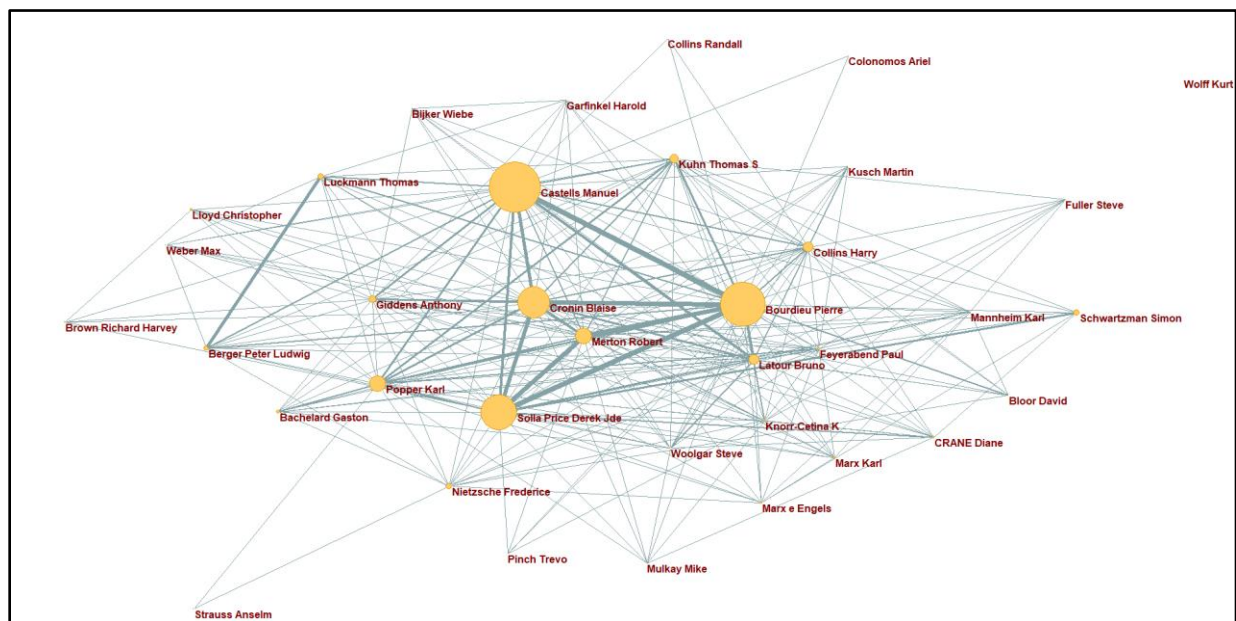
Source: Developed by the authors using Pajek software.

According to Figure 4, Castells is the most cited author, followed by Bourdieu. There is a high incidence of citations between them, which also occurs between Bourdieu and Merton, and Cronin and Solla Price. Price has been recognized for advancing citation studies, especially with regard to the citation standards used in the 1960s, as well as for aiming to develop a science of science (Collins 2015), while Cronin (2008) contributed theoretically to the PQs' production on the social perspective of IS and its librarianship and documentation origins. The four authors present a strong relation of mutual incidence. In a study on IS receptivity to sociology, Cronin (2008) also highlights Bourdieu and Castells among authors widely cited in this field literature, although he does not inform the "[…] historical moment at which the field became somehow sociologically enlightened, or shifted gears paradigmatically as a result of concentrated exposure to insights from mainstream sociology" (Cronin 2008 p. 473).

Therefore, Castells (with his studies on the network society), Bourdieu (who contributed to the understanding of science through scientific fields, which have relative autonomy but also the power to articulate with other social and scientific fields), Solla Price, Cronin, Merton, and Popper – the latter influencing research that approaches the methodology and epistemology of

science – are the most important theoretical references of researchers focused on issues related to sociology in IS studies, constituting an interdomain context to be more extensively explored in future, more targeted studies.

The referent sociologists less cited by the IS researchers, such as Strauss, Colonomos, Randall Collins, and Fuller, are in the most peripheral area of the network, meaning that their contribution to IS is more diffuse due to the recurrence or specificity of themes less discussed in the analyzed period. This is the case of the sociologist Randall Collins, whose study on rituals, addressed in his recent work, Interaction Ritual Chains, is particularly close to authors such as George Herbert Mead, Durkheim, and Erving Goffman, coupling four PQ researchers with minimal incidence and presenting proximity only with the most recent authors of the constellation. The same occurs with Strauss, who, alongside Glaser, created the Grounded Theory, which, in turn, only nears Nietzsche and Popper, while Colonomos relates theoretically to Castells and Bourdieu.

The configurations presented here only show aspects observable through the analyses and interpretations that use modalities of metric studies to approach the domain. Other studies are possible due to the multiple modes of production, which are facilitated by advances in technology and tools for organizing and analyzing data during research development.

5 - Final considerations

In this research, the domain of Information Science in Brazil was analyzed, with its approximations and relationships with the three fields of sociology, here called interdomains.

In view of the analysis and interpretation of the results of this study, overcoming the synthesizing obstacles was possible due to the strategy of recovering the idea that generated the problem, trying to answer the main question about the possibilities of dialogue between sociological studies and IS in terms of knowledge, science, and scientific knowledge. As final considerations, the realization of this interdomain is perceived as a relational process, represented in a common area of the domains or fields of sociology in its perspectives and the IS. We

empirically demonstrated this relation through the analysis of a *corpus* of the scientific production in IS that was related to sociology by the PQs.

To this end, we identified the authors of sociological currents that focus on knowledge, science, and scientific knowledge and that are present in the Brazilian periodical scientific production in IS, represented in Table 1. The table shows the lists of referent authors categorized into three fields: sociology of knowledge, sociology of science, and sociology of scientific knowledge.

After analyzing the similarities and differences between the referent authors, we identified the theoretical identity of the researchers, relating their approximations through the coupling analysis. We also diachronically analyzed the presence of authors from the three fields in the periodical production of the PQ fellows in order to identify the referent authors' coupling intensity.

We observed the prominence of Castells – whose studies on network society were fundamental to the IS researchers' coupling intensity –, as well as Bourdieu – for the understanding of science through scientific fields, which have relative autonomy but also the power to articulate with other social and scientific fields –, Solla Price, Cronin, Merton, and Popper – the latter influencing the production of methodology and epistemology of science. These are the most important theoretical references of researchers focused on sociological issues in IS studies, constituting an interdomain context to be more extensively explored in future studies.

We also observed that the central authors cited by the IS and interconnected to Bourdieu, Cronin, Solla Price, and Castells, from sociology of scientific knowledge, are also the most connected in IS. Furthermore, they are directly close to Merton (more central) and Khun, from sociology of science, and, to a lesser extent, to sociologists of knowledge such as Marx, Engels, and Weber, considering the three fields herein analyzed.

As far as possible, studies on the distinctions and approximations analyzed in this study must be carried out in order to clarify the meanings of this concrete and observable reality from its intrinsic and extrinsic relations. Therefore, the research of the *corpus* represents privileged positions and moments that result from a historical series of exchanges between researchers of the Brazilian IS scientific field.

Notes

(1) Research Productivity Scholarships (PQ) provided by CNPq granted to researchers from all areas of knowledge with the aim of distinguishing their work and valuing their production.

(2) National Council for Scientific and Technological Development is an entity linked to the Ministry of Science, Technology and Innovation to encourage research in Brazil.

(3) Brapci is the acronym for the Reference Database of Journal Articles in Information Science (Brapci). It is the information product whose objective is to support studies and proposals in the area of Information Science, consolidating itself as the largest base of Information Science in Portuguese (http://brapci.inf.br).

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