Network in Network Here's the question?

Network in Network Here's the question?

Article received: 12/07/2021 and accepted: 9/26/2022

Flávio José de Melo
Curitiba - PR
PhD student in Accounting at UFPR[1]
f.j.melo02@gmail.com

Uillian Gustavo Souza Ferreira Rocha de Jesus
Ilhéus - BA
Degree in Accounting from Faculdade de Ilhéus
ferreira.uillian@gmail.com

Nayane Thais Krespi Musial
Curitiba - PR
PhD in Numerical Methods in Engineering from UFPR
nayanethais@ufpr.br

ABSTRACT

The analysis of social networks has been spreading, increasingly in new spaces and forms of communication, especially in the way of interacting and expanding knowledge. The study aimed to analyze which co-authorship connections of interinstitutional scientific publications are established by authors who study social networks. This study is justified by the fact that there are gaps in the literature, considering that there are no bibliometric studies in the area of accounting, with a view to knowing whether those who analyze social networks form a social network in the publications of journals in Accounting. The methodology used was descriptive analysis. The sample consisted of articles published in 15 journals in the accounting area between 2000 and 2020. Statistical tests were performed using Microsoft Office Excel, Ucinet 6,531, Netdraw 2,153 and Wordclouds software. The analysis showed that the institutions with the highest degree of "entry/exit" centrality of this social network were: FEA-USP, UFSC and UFPR. The authors who occupy a prominent role were: ROCHA, DT, CRUZ, JAW BEUREN, I. M and ESPEJO, MMSB The survey showed that 48% of authors who study social networks establish a link, in the interinstitutional relations of co-authorship, in published scientific articles in the accounting area. However, only two groups stood out by casually presenting ties with other institutions. It is concluded that researchers who analyze social networks and publish in accounting journals establish connections with researchers from other institutions, albeit timidly. However, despite the drop in scientific production in recent years, some research groups have been since 2007 without interruption, disclosing their studies to the community online.

Keywords: Social networks; Scientific production; Collaboration networks; Structural relations.

RESUMO

A análise de redes sociais vem se difundindo, cada vez mais em novos espaços e formas de comunicação, sobretudo, na maneira de interagir e ampliar conhecimentos. O estudo teve como objetivo analisar quais conexões de coautoria de publicações científicas interinstitucionais são estabelecidas por autores que estudam redes sociais. Este estudo se justifica por haver lacunas na literatura, tendo em vista não haver estudos bibliométricos na área de contabilidade, com vistas a saber se quem analisa redes sociais, forma rede social nas publicações de periódicos em Contabilidade. A metodologia utilizada foi de análise descritiva. A amostra foi composta por artigos publicados em 15 periódicos da área de contabilidade no período entre 2000 e 2020. Os testes estatísticos foram realizados por meio dos softwares Microsoft Office Excel, Ucinet 6.531, Netdraw 2.153 e Wordclouds. A análise demonstrou que as instituições com maior grau de centralidade "entrada/saída" dessa rede social foram: FEA- USP, UFSC e UFPR. Os autores que ocupam papel de destaque foram: ROCHA, D. T., CRUZ, J. A. W. BEUREN, I. M e ESPEJO, M. M. S. B. A pesquisa demonstrou que 48% dos autores que estudam redes sociais estabelecem vinculo, nas relações interinstitucionais de coautorias, em artigos científicos publicados na área de contabilidade. No entanto, apenas dois grupos se destacaram apresentando laços com outras instituições de maneira casual. Conclui-se que os pesquisadores que analisam redes sociais e publicam em periódicos da área de contabilidade, estabelecem conexões com pesquisadores de outras instituições, ainda que de maneira tímida. No entanto, apesar da queda na produção cientifica nos últimos anos, alguns grupos de pesquisa vêm desde 2007, sem interrupção, divulgando os seus estudos em rede para a comunidade.

Palavras-chave: Redes sociais; Produção cientifica; Redes de colaboração; Relações estruturais.

1. INTRODUCTION

Over the last three decades, social network analysis has been gaining interest in the scientific community. In this model of study, the number of followers is growing (MIZRUCHI, 2006). Marteleto (2001) defines social networks as a set of independent agents, uniting concepts and resources around shared values and interests. Network analysis establishes a new paradigm in research into social structure, which would therefore be applied to social facts based on the interactions of human relations according to their nature, intensity, frequency and generating fact.

The majority of social network studies examine the set of interrelated objects or actors, considered for analytical purposes as delimited social collectives, although in practice these boundaries are often permeable, ambiguous or focal (MARSDEN, 2005). For Silva, Matheus, Parreiras and Parreiras (2006), the analysis of social networks formed between actors is characterized as an instrument that makes it possible to observe the interdisciplinarity of a science that helps, visualizes and analyses cooperation between researchers.

According to Sonnenwald (2006), scientific cooperation emerges from the broader social context of science and is therefore a complex phenomenon whose concept applies to the interaction between groups of actors that includes: peer review, reward systems,

[1] UFPR – Federal University of Paraná – Curitiba – PR – CEP. 80060-000.

invisible faculties, national/international paradigms and scientific policies, as well as subjects and norms applied in universities.

Mueller (2004) explains that scientific production can be viewed by production and activity indicators. These characteristics are based on the number of publications of journal articles, papers published in conference proceedings, books and book chapters, as well as citations "impact factor, productivity index and other bibliometric indicators". In this context, scientific production is the way in which authors communicate their research to academic society and the public. The analysis of congresses, journals and scientific production is carried out in different areas of science and, generally, these studies seek to understand the profile of the authors and the quality of what is being produced (MATOS, et. al., 2012). In the accounting area, scientific production has grown in recent years, and the number of scientific events has increased, including studies that focus on bibliometric analysis techniques (RIBEIRO, 2017).

In general, bibliometric studies with an emphasis on social network analysis seek to highlight the formation of social groups between: institutions, social media, companies, co-authorships in scientific production, among other aspects. In view of the above, the problem question of this study seeks to know: what co-authorship connections of inter-institutional scientific publications are established by authors who study social networks? The study aimed to analyze which co -authorship connections of inter-institutional scientific publications are established by authors who study social networks.

This article is relevant because it fills gaps in the literature, given that there are no bibliometric studies in the area of accounting to find out whether those who analyze social networks form social networks in accounting journal publications. The study brings a new reflection on the scope of research that analyzes social interrelationships in scientific publications, thus instigating new network research in other areas of knowledge. In addition, the study also contributes to highlighting the current state of research in social network analysis in the field of accounting, as well as indicating a posteriori which geodesic paths could be used for future connections between researchers.

2.THEORETICAL FRAMEWORK

2.1 Social networks

Social network analysis has its roots in various theoretical perspectives. The literature describes its origins in the studies of psychiatrist J. L. Moreno (1934), who developed an approach known as sociometry, in which interpersonal relationships were represented by graphs. In addition to these, other contributions are described in the studies of John Barnes "1954", Elizabeth Bott "1957" and J. Clyde Mitchell "1969", Claude Lévi-Strauss "1969", Berkowitz "1982", Wellman "1988" and Mizruchi, 2006.

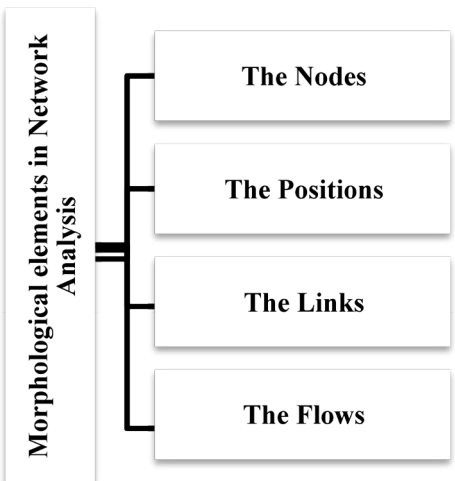
Social networks are representations in the form of graphs that simulate the relationships that exist between groups. They are also understood as a set of elements: actors, who can be people, institutions or groups, and their connections, which identify various characteristics (GRANOVETTER, 1973; DEGENNE; FORSE, 1999; ESTEVES; BOTELHO, 2013). In the most basic sense, a social network is any pair or collection of objects connected by links. However, participants in a network can occupy a more centralized or peripheral position and can even cross borders in different regions, depending on how they are connected (EASLEY; KLEINBERG, 2010). In addition, Marteleto (2001) points out that informal networking is a form of human organization, present in people's daily lives at different structural levels, where the value placed on relationships and links is mainly to the detriment of the hierarchical structure.

The focus of social network analysis (SNA) is to study the existing ties and characteristics of a network and how these connections are made. For Gomide and Schütz (2015), these ties comprise the dynamics of interactions through new connections or the breaking of existing ones, which can influence the information circuit, compromising or favoring results and their use. In this way, network studies can be used as a strategy to verify existing connection flows and identify aspects such as centrality and prestige (SILVA, et. al., 2012).

Koput (2010) explains that a social network implies a pattern of social ties formed between a group, such as students, councils, among others. The purpose of analyzing social networks in organizations is to understand the dynamics of how the informal structure operates in conjunction with the formal structure and how the flow of this work is distributed. In this conception, social interactions reflect a complex labyrinth of networks that connect people who share information, ideas, perceptions, beliefs, myths, rumors, etc (GARCÍA; SÁN- CHEZ-CABEZUDO, 2016). In addition to common networks (directed, non-directed and mixed), some types of networks are also considered useful, such as temporal networks (or dynamic networks) that change over time, multi-relational networks that highlight different relationships, and specialized networks, among others (BATAGELJ, et. al., 2014).

Silva et al. (2006) point out that multi-relational networks are those in which there is more than one type of link, i.e. more than one relationship, such as dyads and triads. The concepts applied to these relationships classify dyads as links between two actors and triads as three actors which, respectively, can involve groups or subgroups in a social network (PRYKE, 2012). Social network analysis has been applied in various fields of knowledge, including viral marketing, social media analysis, social research, etc. (CHEN; LAKSHMANA; CASTILLO, 2013).

Figure 1 - Elements for network analysis



Source: Adapted from Britto (2002).

The structural analysis of networks has made two important contributions: the first by providing precise definitions about the structure of relationships and the second by showing concrete measures for the notion of power, considering various approaches that link the positions of the actors (HANNEMAN; RIDDLE, 2005). Social networks are a fundamental theoretical and methodological resource for studies whose assumptions seek to analyze organizations as systems of meanings constructed from the relationships and connections between the actors in an organization (BASTOS; SANTOS, 2007). According to Silva et al. (2006), social network analysis is based on the mathematical language of graphs, con-

sidered to be structures made up of nodes or vertices connected by a set of lines, or edges, which correspond to the ties between the actors.

Britto (2002), addressing the concepts that arise from network analysis in conjunction with the theoretical paradigms of structural graph analysis, lists four morphological elements used in the presentation: nodes, positions, links and flows (Figure 1). Nodes can be described as the companies or other activities inherent in the organizations that make up a network. The position of an actor is defined by the location each actor is in. The connections (linkages) refer to the relationships that determine the degree of density of the actors and, finally, the flows that establish the communication through which resources and information flow.

Sacomano Neto and Truzzi (2004) point out that it is through linkages that resources and interactions between members of a group flow in power relations. In the so-called modern social network analysis, four "combination" approaches in conducting structural research are used, which together define the field and resources needed to analyze social phenomena. The social network analysis integrated into this organized research paradigm is motivated by: a structural view based on ties; systematic empirical data; mathematical/computational models; and graphic images (FREEMAN, 2004).

2.2 Graph Theory

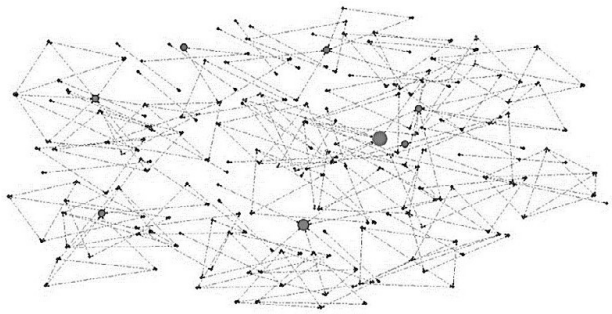
Graph theory had its origins in the eighteenth century in the seminal work of the Swiss mathematician Leonhard Euler (1736), who discussed and solved a puzzle now known as the Königsberg bridge problem. Euler's study was fundamental to graph theory and contributed to mathematics (BIGGS, LLOYD, WILSON, 1986; BARABÁSI, ALBERT, 2002; GONÇALVES, 2007). The theory of graphs has its origins in the confrontation of practical problems, unlike other branches of mathematics that are purely the result of theoretical speculation. Graphs are, in summary, figures formed by sets of vertices and edges. When vertices are connected by edges, they are called neighbors or adjacent (FEOFILOFF, KOHAYAKAWA, WAKABAYASHI, 2011).

Graph theory offers a representation of a social network modeled on a graph which consists of representing a set of actors (nodes) connected to each other by lines (BARBOSA; BYINGTON; STRUCHINER, 2000). Social network analysis uses this tool to carry out structural analysis, which from this point of view, using graphs, the vertices are the actors, and the edges are their relationships (RECUERO, 2008).

Regarding the analysis of the relationships between the actors in a given set, graphs in the literature are defined as a set V of vertices (or nodes) and a set E of edges, i.e. a graph is a pair G = (graph V, E) of sets such that E ⊆ [V] 2. Thus, the elements of E are subsets of the 2 elements of V. Graphical representations may or may not be directed. Directed graphs have their connections represented by arrows that indicate the direction of these connections (also called a digraph) and the edges (also called arrows) determine the direction, which means that the edge starts from node A and reaches node B. In the undirected graph, there is no such order relationship between the connections (DIESTEL, 2005; DIGIAMPIETRI, SILVA, 2011; LÉZORAY; GRADY, 2012).

The representation of relationships between groups of individuals are graphs called sociograms. These reproductions serve as a method of exploration that enables the structural analysis of a collectivity. Subgroups are one of the main elements influencing interactions and should be clearly displayed (VAZ, 2009). Figure 2 shows the interaction between the actors in a social network through the visual representation of a sociogram.

Figure 2 - Graphical representation of interactions.



Source: Research data (2021).

Braga (2008) compares the modeling of a graph representation to the everyday relationships of individuals in society, stating that when one person meets another, they easily discover that, from this new contact, there may be other contacts in common with finitesimal statistical probabilities. However, scientists do not accept the term coincidence and seek to determine how these natural phenomena behave.

The metrics offered by this theory help to understand, through the data collected from a network: the nature of social ties, social capital and its influence on the social structure of the actors who make up the network (RECUERO, 2014).

Based on research into network theories, various studies have emerged in practically all traditional areas of organizational studies, and the centrality measure of an actor has come to be seen as one of the most important and widely used conceptual tools for analyzing networks and trying to identify the most important actors (BORGATTI; FOSTER, 2003; EVERETT; BORGATTI, 2005). However, in addition to centrality, Minhoto and Meirinhos (2011), Conceição, et. al., (2015) emphasize that in the literature on networks some important "variable" indicators are often used to characterize social networks, such as: size, connections and structure of the network or even the relationship of reciprocity and interconnections between group members.

According to Balestrin, Verchoore and Reyes Junior (2010), geodesic centrality (Eigenvector) and Betweenness centrality are seen as measures that indicate the central concepts in the investigation of inter-organizational cooperation networks. Íñiguez, et. al., (2006) point out that the size of a network, the form of integration, and the number of connections are essential information for knowing the level of inclusion and influence "power" that an actor exercises in a given network. These indicators help to give an idea of the diffusion, homogeneity and cohesion of a network's properties.

Rossoni and Guarido Filho (2009) conducted a study to see if there are cooperation structures in postgraduate programmes in Administration in Brazil, among different thematic areas: science and technology; strategy; public administration; and organizational studies. The results of this study reinforce the idea of stratification, which associates productivity conditions with the degree of centrality.

3. METHODOLOGICAL PROCEDURES

This study is characterized as descriptive. According to Raupp and Beuren (2003), the main objective of this research model is to describe the characteristics of a population, as well as the possible relationship between two or more variables. In terms of objective, the research is characterized as documentary. Documentary research allows researchers to interpret and synthesize information in order to create new ways of understanding phenomena and trends, based on analysis (SÁ-SILVA; ALMEIDA; GUINDANI, 2009).

The descriptive research was carried out using bibliometric analysis. Bibliometric studies, formerly called "statistical bibliography", is a quantitative technique for measuring and drawing up indices of scientific and academic production, which is done by applying statistical and mathematical methods to analyze aspects not only of literature, but also of other media (ARAÚJO, 2006). Bibliometrics and Scientometrics are quantitative evaluation techniques, and their function is to measure scientific knowledge and the flow of information in a given area (ROSA, et. al., 2009). Documentary research can be confused with bibliographic research due to its characteristics, the main difference being the nature of the sources. The former is based on materials that have not yet received analytical treatment, while the latter mainly uses the contributions of various authors on the subject of study (RAUPP; BEUREN, 2003).

3.1 Population and Sample

The universe of the study is made up of publications of scientific articles with an emphasis on social network analysis available in accounting journals in Brazil, between 2000 and 2020, classified in the Qualis-Capes system 2013-2016, with concepts from A2 to B2 in the areas of Public and Business Administration, Accounting Sciences and Tourism. The criterion for selecting the scientific journals was based on the words "accounting and accountancy" in the titles of the journals, since there are publications on social network analysis in other areas of knowledge, such as tourism, management and economics, which was not the scope of this study. Table 1 shows the final sample of 15 journals surveyed.

The articles were selected by means of an automatic search on the websites of the journals analyzed. The selection criterion was based on the presence of the following terminologies: network, scientific production, social networks, collaboration, social network, co-authorship and centrality, in the titles, abstracts and keywords. The search resulted in a total of 90 articles. However, nine of these were excluded because they dealt with the following themes: neural network analysis and networks of items shown in environmental reports which, despite containing the term "network" in their abstracts, did not include social network analysis, which is the subject of this study. Thus, the final sample consisted of 81 articles.

3.2 Procedures for Data Collection and Analysis

The techniques for analyzing the formation of social networks and co-authorship in scientific publications were performed using Microsoft Office Excel, Ucinet 6.531, Netdraw 2.153 and Wordclouds software. The Ucinet software makes it possible to create and mathematically manipulate matrices that represent the relationships in a network. In addition, the NetDraw software is part of the package for visualizing graphs in two dimensions (BEZ; FARACO; ANGELONI, 2011).

Scott, et. al. (2005) point out that the Ucinet software is used to calculate quantitative measures of network structure, including density, centralization, hierarchy and clustering coefficient "the degree to which the nodes of a graph tend to group together". The software also generates visual representations of networks using diagrams.

The data was operationalized in four stages: the first stage consisted of coding the names of the institutions in a specific table, and in the same way for the group of co-authors. In the next phase, the actors in the sample were coded using numerical codes to obtain the binary measures. The data analysis was performed by drawing up contingent tables for interactions between institutions, and in the same way for co-authorship analysis. The criterion for this analysis was "1" for the interactions and "0" for the others.

Table 1 - Research sample

ACCOUNTING JOURNALS			
1	Enfoque Reflexão Contábil	9	Revista Contemporânea de Contabilidade
2	BASE - Revista de Administração eContabilidade da Unisinos	10	Revista de Contabilidade do Mestrado em Ciências Contábeis da UERJ
3	RCO - Revista de Contabilidade e Organizações	11	Revista de Educação e Pesquisa em Contabilidade - REPeC
4	Pensar Contábil	12	Revista de Gestão, Finanças e Contabilidade
5	Revista Catarinense da Ciência Contábil	13	Revista Universo Contábil
6	Revista Contabilidade & finanças	14	Sociedade, Contabilidade e Gestão
7	Revista Contabilidade Vista & Revista	15	Tecnologias de Administração e Contabilidade
8	Revista Contabilidade, Gestão e Governança		

Source: Research data (2021).

This was followed by the operationalization of the routines for calculating the indicators: network centrality and degree of intermediation, and finally, sociograms were generated using NetDraw software.

Wordclouds was used to check the frequency of occurrence of words in the title, abstract and keywords, in order to generate a word cloud. The main limitation of this study refers to the methodological aspects, as there were no questionnaires, interviews or discourse analysis.

4. ANALYSIS AND DISCUSSION OF RESULTS

4.1. Descriptive analysis

To characterize the sample, it was checked which were the main themes covered in the titles of the articles published in national journals. In order to analyze the articles, a word cloud graph was used as the analysis technique. The lexical analysis is noteworthy in that it makes it possible to quickly identify the key words in the textual corpus. Word cloud analysis shows a graphic representation of the most frequent vocabularies (CAMARGO; JUSTO, 2013; SILVA, BOUSFIELD; CARDOSO, 2013).

Figure 3 shows the most frequently reported words in the titles of the articles in the sample. The analysis showed that the most frequent words were: accounting, analysis, production and networks. The visual cloud display considers mainly the volume of words, to proportionally represent the number of repeated words present in the analyzed content. Thus, the most frequent words are highlighted, as well as having stronger colors.

Figure 3 - Word cloud based on article titles

Source: Research data (2021).

Lemos (2016) points out that textual analysis in tag clouds helps with content analysis and allows for the hierarchical classification of the most frequent words in the text, through quantitative visual representation.

The production of articles analyzing social networks in accounting journals has increased in the last decade (Table 1). The research found that of the total of 81 articles found, the period of greatest scientific production was 2014 with a total of 9 articles, which represents 11.11% of the total, and respectively 2010, 2011 and 2013 with 8 articles published each.

Table 1: Evolution of Scientific Production

YEAR	QUANT.OF ARTICLES	%	YEAR	QUANT.OF ARTICLES	%
2000	0,0	0,0	2011	8,0	**9,88**
2001	0,0	0,0	2012	7,0	8,64
2002	0,0	0,0	2013	8,0	**9,88**
2003	0,0	0,0	2014	9,0	**11,11**
2004	0,0	0,0	2015	7,0	8,64
2005	1,0	1,23	2016	4,0	4,94
2006	0,0	0,0	2017	5,0	6,17
2007	1,0	1,23	2018	7,0	8,64
2008	3,0	3,70	2019	4,0	4,94
2009	5,0	6,17	2020	4,0	4,94
2010	8,0	**9,88**			

Source: Research data (2021).

The years 2012, 2015 and 2018 also showed significant figures with the production of 7 articles in the sample, suggesting that the social network analysis model is also becoming increasingly popular in the applied social sciences sector. In the first decade, there was a gradual increase in the number of research papers published in accounting journals, with one article published in 2005 and 2007, three in 2008 and five in 2009 and 2017. In 2016, 2019 and 2020, only four articles were published.

Table 2 shows the number of authors per article analyzing social networks. The results showed a greater connection in pairs 28%, followed by teams with three authors 27% and four authors 25%.

Table 2 - Distribution of authors per article

QUANTITY OF AUTHORS	NO. OF ARTICLES	%
One author	08	10
Two authors	23	**28**
Three authors	22	**27**
Four authors	20	**25**
Five authors	05	06
Six authors	02	03
Seven authors	01	01
Total	**81**	**100**

Source: Research data (2021).

The analysis of the relationships between the actors in a network has been used to measure the social structure of scientific cooperation in various studies. Next, the indicators inherent in the formation of social networks were analyzed for the institutions that are part of this study.

Pinto, et. al. (2007) explain that quantitative statistical metrics are fundamental to allow the observation of other aspects in social relations, which can be obtained through indicators such as: densities, centralities, intermediations, proximities, graphs and vectors. In this study, we opted only for the indicators of centrality, intermediation and spatial representations by means of sociograms.

Table 3 shows that only 46 institutions had a degree of Freeman centrality (betweenness centrality) above zero. The Universidade de São Paulo (FEA- USP) and the Universidade Federal de Santa Catarina (UFSC) had the highest degree of centrality with 0.175. However, FEA- USP stood out for having the highest degree of betweenness, in the order of 2.256. In third place was the Universidade Federal do Paraná (UFPR), with 0.123 centrality, followed by the Pontifícia Universidade Católica do Paraná (PUCPR) with 0.105. The degree of centrality shows the number of direct relationships that the actors in a given institution have with the other members of the group.

According to Hesford and Brueggemann (2007), centrality represents the level of influence a given actor has over a network community. Although the Universidade Federal do Rio Grande (FURG) is not one of the central actors in this network, it has the highest degree of intermediation, with 2,548. In addition, the Pontifícia Universidade Católica de São Paulo (PUC-SP) and the Universidade Federal da Bahia (UFBA) also rank highly with 2,475 and 2,059 respectively. 2,059 respectively.

Table 3 - Freeman centrality (degree) and betweenness

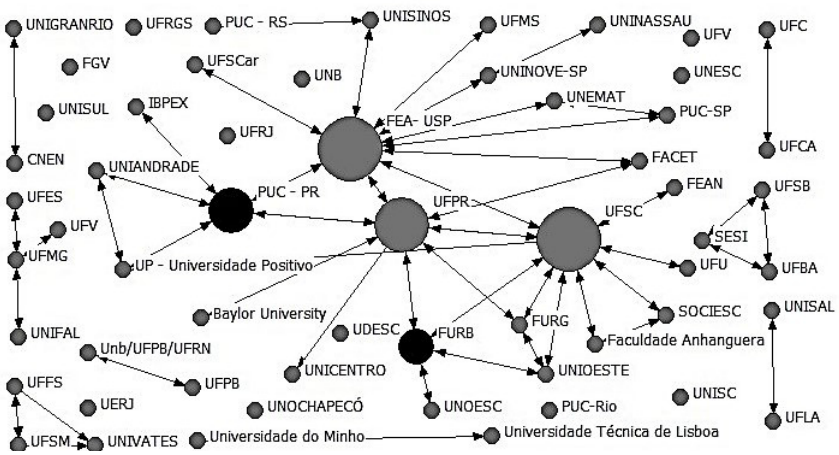
INSTITUTION	G.C.	G.I.	INSTITUTION	G.C.	G.I.	INSTITUTION	G.I.	
FEA- USP	**0.175**	**2.256**	SESI	0.053	0.000	UFES	0.018	0.000
UFSC	**0.175**	0.491	UNIANDRADE	0.053	0.611	UFFS	0.018	0.000
UFPR	**0.123**	**1.709**	FEAN	0.018	0.000	UFSCar	0.018	0.000
PUC - PR	**0.105**	1.660	UFPB	0.018	0.627	IBPEX	0.018	0.000
FURB	**0.070**	0.550	UNOESC	0.018	0.305	Baylor University	0.018	0.000
UFMG	0.053	1.253	UNINASSAU	0.018	0.000	UFMS	0.018	0.000
UNIOESTE	0.053	0.010	UNICENTRO	0.018	0.000	UFV	0.000	0.000
FURG	0.053	**2.548**	UFV	0.018	0.000	UFRGS	0.000	0.000
UP	0.053	0.611	UFU	0.018	0.104	FGV	0.000	0.000
UNINOVE-SP	0.035	0.000	PUC - RS	0.018	0.000	UNISUL	0.000	0.000
UFBA	0.035	**2.059**	UNISAL	0.018	0.000	UNB	0.000	0.000
SOCIESC	0.035	0.000	UFLA	0.018	0.000	UNESC	0.000	0.000
Fac. Anhanguera	0.035	0.000	UNIFAL	0.018	0.000	UERJ	0.000	0.000
FACET	0.035	0.000	Univ. do Minho	0.018	0.000	UNOCHAPECÓ	0.000	0.000
UNISINOS	0.035	0.000	Univ. Téc. Lisboa	0.018	0.000	UNISC	0.000	0.000
UNIVATES	0.035	0.627	Unb/UFPB/UFRN	0.018	0.000	UFRJ	0.000	0.000
UFSM	0.035	0.000	UNIGRANRIO	0.018	1.347	PUC-Rio	0.000	0.000
PUC-SP	0.035	**2.475**	CNEN	0.018	0.000	UDESC	0.000	0.000
UNEMAT	0.035	0.000	UFCA	0.018	0.000		0.000	0.000
UFSB	0.035	0.000	UFC	0.018	0.000		0.000	0.000

Note: G.C - Degree of Centrality, G.I - Degree of Intermediation. | Source: Research data (2021).

The structure of a network represented by a graph is the key to understanding the complex world around us, which includes scientific collaboration relationships. This mapping allows us to see and compare current situations with others we have already experienced, observe the possibilities and changes brought by new contacts, and understand the mechanisms that shape the evolution of scientific collaboration (VANZ, 2013).

The sociogram (Figure 4) shows the structure of the cooperation networks formed between the actors in this network. Of the total of 81 articles, 42 publications did not show interactions with researchers from other institutions, and 39 connections were found between institutions, thus accounting for a total of 58 nodes. The study found the individual production of eight articles, and interactions in dyads with a total of five articles, triads with two articles and one in quadriads. The central players in this network - FEA- USP, UFSC and UFPR - established the largest number of connections. The network formed by this group totaled 26 direct and indirect connections.

Figure 4 - Structure of cooperation networks between institutions



Source: Research data (2021).

In social network analysis, geodesic distance is the shortest way for a node to reach other nodes in the network. Location or spatial proximity enables greater interaction and communication between the actors in a network. It is worth noting that the denser the

Table 4 - Freeman centrality (degree) and betweenness

ACTOR	G.C.	G.I.	ACTOR	G.C.	G.I.
ROCHA, D. T.	0.084	1.475	GIRÃO, L. F. A. P.	0.053	0.945
CRUZ, J. A. W	0.084	0.431	COSTA, F.	0.053	0.254
BEUREN, I. M.	0.042	2.206	JUNIOR, C. M.	0.018	0.011
ESPEJO, M. M. S. B.	0.042	0.744	SOUZA, M. T. S.	0.018	0.011
SANTOS, V.	0.037	1.035	CAMPANÁRIO, M. A.	0.018	0.000
MUNHOZ JUNIOR, J.	0.037	0.138	CORRÊA, R.	0.018	0.000
ENSSLIN, S. R.	0.031	0.000	QUINTELLA, R. H.	0.018	0.000
ANDRICH, R. G.	0.031	0.004	ALMEIDA FILHO, N. M.	0.018	0.000
TARDELLI, M.	0.031	0.004	COUTINHO, D. M. B.	0.018	0.000
REIS, J. A. F.	0.031	0.850	ALMEIDA, K. N. T.	0.018	0.459
ARAÚJO, D. P.	0.031	0.001	BRAGA, J. J. S.	0.018	0.459
RODRIGUES, K. M.	0.031	0.001	BASTOS JUNIOR, E.	0.018	0.000
CITADIN, M. W.	0.031	1.271	AZEVEDO, M. B.	0.018	0.000
NASCIMENTO, S.	0.031	0.000	AIRES, O. A. M.	0.018	0.000
SANTOS, F. L. X.	0.026	0.181	SCHMITZ, T.	0.018	0.000
ABDALLA, K. G. M. Z.	0.026	0.060	DALLABONA, L. F.	0.018	0.000
CRUZ, A. P. C.	0.026	0.000	TRUPPEL, E. K.	0.018	0.000
RIBEIRO, H. C. M.	0.026	0.827	TRUPPEL, L.	0.018	0.000
DAL-RI MÚRCIA	0.026	0.518	VENDRAMIN, E. O.	0.018	0.000
BALDISSERA, J. F.	0.026	0.959	LIMA, J. P. R.	0.018	0.459

Note: G.C - Degree of Centrality, G.I - Degree of Intermediation. | Source: Research data (2021).

network, the shorter the geodesic paths. This suggests that information can travel faster in the network and make the actors more accessible.

In academic circles, studies that carry out social network analysis generally seek to verify the relationships or sharing of knowledge between actors or educational institutions. In the accounting area, there is no study that quantitatively shows whether researchers who use this analysis methodology publish individually or with co-authors, forming links with other research groups. To answer this question, Freeman's degree of betweenness centrality and the degree of betweenness for authors were also analyzed. Considering that the final sample included 192 nodes, it was decided to present in Table 4 a reduced form with only the top 40 authors in this network.

The results showed that the most prolific authors were: ROCHA, D. T. and CRUZ, J. A. W. with a centrality of 0.084. The authors BEUREN, I. M. and ESPEJO, M. M. S. B. ranked second with 0.042, followed by SANTOS, V. and MUNHOZ JUNIOR, J. with 0.037. The authors with the highest degree of intermediation were: BEUREN, I. M. in first place with 2.206, ROCHA, D. T. in second place with 1,475 and CITADIN, M. W. with 1,271.

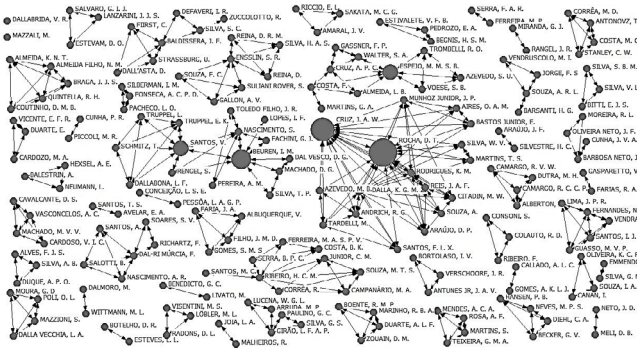
The co-authorship of a work can be characterized as the documentation of a collaboration between two or more authors, with this cooperation within the academic community providing underlying standards for the interrelationship between these actors (NEWMAN, 2004). Social networks can present ties formed by dyads, triads or groups (WASSERMAN; FAUST, 1994).

The main constructs that make up social network research have examined a wide range of connections that are typically called multiplex ties, i.e. actors share more than one type of tie. These connections include communication ties (such as: who talks to whom, or who gives information to whom), formal ties, affective ties (who trusts whom), material or workflow ties (who shares with whom), cognitive ties, among others (KATZ, et. al., 2004).

Figure 5 visually shows that the co-authorship network was made up of 192 nodes. With regard to the connection between the actors in this network, 8 individual productions were counted. Although the sociogram only shows the authors DALLABRIDA, V. R. and MAZZALI, M., the lack of visual representation of 6 articles produced individually by the authors RIBEIRO, H. C. M., and SILVA, G. M. was due to their interaction with other researchers.

Most of the articles were formed by “14 dyads”, “12 triads” and “10 quadriads”. In addition, the two main groups formed had several connections: the one formed by ROCHA, D. T. and CRUZ, J. A. W. had 16

Figure 5 - Structure of the cooperation networks between the authors



Source: Research data (2021).

nodes and BEUREN's had 15 nodes. It should be noted that the actor with the highest degree of centrality in the social network is not always the one who establishes the greatest flow of interactions between the actors, given that, despite BEUREN, I. M. is not the central actor in this network, he has a greater degree of intermediation.

The concept of betweenness refers to the degree of global centrality, which implies demonstrating the importance of an actor in mediating connections along the shortest possible path (NOOY; MRVAR; BATAGEL, 2005; BORDIN; GONÇALVES; TODESCO, 2014). In this context, proximity to high-performance researchers can strengthen ties with the academic community and promote the development of new research projects in partnership with other institutions.

Finally, the results showed that 48% of the researchers conducting studies on social network analysis in the field of accounting established connections with authors from other institutions and 52% published individually or with members of their own institution. This suggests poor communication between the actors, since the links were restricted to just two groups.

Back et. al. (2005) point out that knowledge networks should be considered as a dynamic rather than static structure, given that this relationship structure shares a common language and a set of values and objectives that can accumulate and transfer knowledge. In this context, the formation of social networks must represent interactions and knowledge that transcend the intelligence of any of its individual members (KABO, 2018).

The potential of networks comes from the social capital they embody, in the sense of the advantages an individual can gain through these connections. This advantage is created by a person's location in the structure of a network's relationships. Social capital explains, for example, how people perform better if they are somehow more connected to others (BURT, 2005; BURTON; WU; PRYBUTOK, 2010).

5. FINAL CONSIDERATIONS

Social network analysis is becoming increasingly popular in several areas of academia. Research using this model generally seeks to highlight relationships between groups that share knowledge. The aim of this study was to verify whether authors who study social networks establish connections in co-authoring inter-institutional scientific publications.

In the interaction between the institutions researched, the results showed that the central actors in this network were: FEA- USP, UFSC, both with a centrality of 0.175, and UFPR with 0.123. However, FEA-USP stands out from the others, as it has more intermediation, which establishes a position of power, by strengthening ties with other members of the group. Establishing links with groups from different institutions enables the creation of new contacts, access to information and visibility in the power relationship.

The authors ROCHA, D. T. and CRUZ, J. A. W. ranked first in Freeman's centrality indicators, followed by the researchers BEUREN, I. M and ESPEJO, M. M. S. B. in second place in the structural relationships of this network. The analysis of mediation centrality showed that the most prominent authors were: BEUREN, I. M., ROCHA, D. T. and CITADIN, M. W. In general terms, the study showed that 48% of the authors who study social networks establish links in inter-institutional co-authorship relationships in scientific articles published in the field of accounting. However, only two groups stood out as having ties with other institutions on a casual basis.

It can be concluded that researchers who analyze social networks and publish in accounting journals establish connections with researchers from other institutions, albeit timidly. However, despite the drop in scientific production in recent years, some research groups have been disseminating their network studies to the community without interruption since 2007.

As a limitation of the study, we would highlight the size of the sample, given that journals from other areas of knowledge, such as accounting, economic sciences, organizational management, etc. publish articles in the area of accounting.

For future research, it is suggested that the study be extended to other areas of knowledge, as well as using other indicators that allow in-depth analysis between institutions and co-authors in scientific production.

REFERENCES

ARAÚJO, C. A. A. Bibliometria: Evolução Histórica e Questões Atuais. *Em Questão*, v.12, n.1, p.11–32, 2006.

BACK, A.; RAIMANN, J.; VON KROGH, G.; VASSILIADIS, S.; SEUFERT, A.; WICKI, Y.; ENKEL, E. *Putting Knowledge Networks into Action: Methodology, Development, Maintenance*, Springer, Berlin, 2005.

BALESTRIN, A.; VERCHOORE, J. R.; REYES JUNIOR, E. O Campo de Estudo Sobre Redes de Cooperação Inter Organizacional no Brasil. *Revista de Administração de Empresas*, v.14, n.3, p.458-477, 2010.

BARABÁSI, A. L.; ALBERT, R. *Statistical mechanics of complex networks, Review of Modern Physics*, v.74, p.47-94, 2002.

BARBOSA, M. T. S.; BYINGTON, M. R. L.; STRUCHINER, C. J. Modelos Dinâmicos e Redes Sociais: Revisão e Reflexões a Respeito de Sua Contribuição Para o Enfrentamento do HIV. *Cadernos de Saúde Pública*, v.16, n.1, p.37– 51, 2000.

BARNES, J. A. Class and committees in a Norwegian island parish. *Human Relations*, v.7, n.1, p.39-58, 1954.

BASTOS, A. V.; SANTOS, M. V. Redes sociais informais e compartilhamento de significados sobre mudança organizacional. *Revista de Administração de Empresas*, v.47, 3, p.27-39, 2007.

BATAGELJ, V.; DOREIAN, P.; FERLIGOJ, A.; KEJZAR, N. *Understanding large temporal networks and spatial networks: Exploration, pattern searching, visualization and network evolution*. New York: Wiley, 2014.

BERKOWITZ, S. D. *An Introduction to Structural Analysis*. Toronto: Butterworths,1982.

BEZ, G. S.; FARACO, R.; ANGELONI, M. T. Aplicação da técnica de análise de redes sociais em uma Instituição de Ensino Superior. *Perspectivas Contemporâneas*, v.6, p.53-78, 2011.

BIGGS, N.; LLOYD, E.; WILSON, R. *Graph Theory,* p.1736-1936, Oxford University Press, 1986.

BORDIN, A. S.; GONÇALVES, A. L.; TODESCO, J. L. Análise da colaboração científica departamental por meio de redes de coautoria. *Perspectivas em Ciência da Informação*, v.19, n.2, p.37-52, 2014.

BORGATTI, S.P.; FOSTER, P.C. The network paradigm in organizational research: a review and typology. *Journal of Management*. Orlando, v.29, n.6, p.991-1013, 2003. BOTT, E. *Family and Social Network: Roles, Norms, and External Relationships in Ordinary Urban Families*. London: Tavistock, 1957.

BRAGA, M. J. C.; GOMES, L. F. A. M.; RUEDIGER, M. A. Mundos pequenos, produção acadêmica e grafos de colaboração: um estudo de caso dos ENANPADS. *Revista de Administração Pública*, v.42, n.1, p.133-154, 2008.

BRITTO, J. Redes de cooperação entre empresas. *Estrutura de mercado e inovação*. In: Kupfer, D.; Hasenclever, L. Economia Industrial: fundamentos teóricos e práticas no Brasil. RJ: Campos, 2002.

BURT, R. S. *Brokerage and closure*. Oxford, UK: Oxford University Press, 2005.

Burton, P., Wu, Y.; Prybutok, V. Social network position and its relationship to performance of it professionals. Informing Science. *The International Journal of an Emerging Transdiscipline*, v.13, p.121-137, 2010.

CAMARGO, B. V.; JUSTO, A. M. Irumuteq: um software gratuito para análise de dados textuais. *Temas psicológicos*, v.21, n.2, p.513 – 518, 2013.

CHEN, W.; LAKSHMANAN, L. V. S.; CASTILLO, C. *Information and influence propagation in social networks*. San Rafael: Morgan & Claypool Publishers, 2013.

CONCEIÇÃO, A. H. Q.; MOLLO NETO, M.; SHIBUYA, M. K.; CAPELAS, M.; CONCEIÇÃO, L. F. M. Análise da Rede Interorganizacional do Turismo: Um Estudo no Município de Manacapuru – Amazonas. *Revista Gestão & Saúde*, v.6, p.1082-1095, 2015.

DEGENNE, A.; FORSÉ, M. *Introducing Social Networks*. London: Sage, 1999.

DIESTEL, R. *Graph theory*. 5. ed. New York: Springer, 2005.

DIGIAMPIETRI, L. A.; SILVA, E. E. A framework for social network of researchers analysis. *Iberoamerican Journal of Applied Computing*, v.1, n.1, p.1-24, 2011.

EASLEY, D.; KLEINBERG, J. *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*. Cambridge: Cambridge University Press, 2010.

ESTEVES, L. L.; BOTELHO, D. R. Autores Centrais no Desenvolvimento da Rede Colaborativa: Análise da Revista Contabilidade, Gestão e Governança de 1998 a 2012. *Contabilidade, Gestão e Governança*, v. 16, n.3, p.41-57, 2013.

EVERETT, M. G.; BORGATTI, S. P. *Models and methods in social network analysis*. Extending centrality. In: CARRINGTON, P., SCOTT, J. WASSERMAN, S. (organizadores). New York: Cambridge Press, 2005.

FEOFILOFF, P.; KOHAYAKAWA, Y.; & WAKABAYASHI, Y. *Uma Introdução Sucinta à Teoria dos Grafos*. São Paulo, 2011.

FREEMAN, L. C. *The development of social network analysis: a study in the sociology of science*. Vancouver: Empirical, 2004.

GARCÍA, M. F.; SÁNCHEZ-CABEZUDO, D. A. J. S. Identifying the new Influencers in the Internet Era: Social Media and Social Network Analysis. *Revista Española de Investigaciones Sociológicas*, v. 153, p.23-40, 2016.

GOMIDE, M.; SCHÜTZ, G. E. Análise de Redes Sociais e práticas avaliativas: desafios à vista. *Physis. Revista de Saúde Coletiva (UERJ. Impresso)*, v.25, P.819-842,2015.

GONÇALVES, A. L. *Grafos: Aplicações ao jogo*. (Unpublished master´s thesis). Porto: Universidade Portucalense Infante D. Henrique, 2007. GRANOVETTER, M. *The strength of weak ties*. *Am J Sociol*., v.78, p.1360-1380, 1973.

HANNEMAN, R. A.; RIDDLE, M. *Introduction to Social Network Methods*. Edição: University of California. Riverside, 2005.

HESFORD, W. S.; BRUEGGEMANN, B. *Rhetorical Visions: Reading and Writing*. In: a Visual Culture. 2nd ed. Boston: Pearson/Longman, 2007.

ÍÑIGUEZ, L.; MUÑOZ, J.; PEÑARANDA, M. C.; MARTINEZ, L. M. La Psicología Social em España: Estructuras de Comunidades. *Redes – Revista Hispana para el Análisis de Redes Sociales*, v.10, n.3, p.1- 23, 2006.

KABO F., The architecture of network collective intelligence: correlations between social network structure, spatial layout and prestige outcomes in an office, *Philosophical Transactions of the Royal Society B: Biological Sciences*, 73, n.1753, p.1-9, 2018,

KATZ, N.; LAZER, D.; ARROW, H.; CONTRACTOR, N. Network theory and small groups. *Small Group Research*, 35, 307-332, 2004. KOPUT, K. W. *Social capital an introduction of managing networks*. Northampton: Edward Elgar Cheltenham, v.177, 2010.

LÉVI-STRAUSS, C. *Elementary Structures of Kinship*. Boston: Beacon, 1969.

LEMOS, L. M. P. Nuvem de tags como ferramenta de análise de conteúdo: uma experiência com as cenas estendidas da telenovela Passione na internet. *Lumina*, v. 10, n.1, p.1–18, 2016.

LÉZORAY O.; Grady, L. *Graph theory concepts and definitions used in image processing and analysis*. In: Lézoray, O, Grady, L. (eds). Image processing and analysing with graphs: theory and practice. CRC Press, Boca Raton, 1–24, 2012.

MARTELETO, R. M. Análise de redes sociais – aplicação nos estudos de transferência deinformação. *Ciência da Informação*. Brasília, v.30, n.1, p.71-81, 2001.

MARSDEN, P. V. Recent Developments in Network Measurement. In: CARRINGTON, P.J.; SCOTT, J.; WASSERMAN, S., Eds., *Models and Methods in Social Network Analysis*, Cambridge University Press, Cambridge, v.7, p.8-30, 2005.

MATOS, E. B. S.; ARAÚJO NETO, L. M.; NIYAMA, J. K.; MARQUES, M. M. Congresso ANPCONT: Análise Bibliométrica Descritiva e Avaliativa dos Artigos Publicados de 2007 a 2011. *Enfoque: Reflexão Contábil*, v.31, n.3, p.73-88, 2012.

MINHOTO, P.; MEIRINHOS, M. As redes sociais na promoção da aprendizagem colaborativa: um estudo no ensino secundário. *Educação, Formação & Tecnologias*, v.4, n.2, p.25-34, 2011.

MITCHELL, J. C. *Social Networks in Urban Situations*. Manchester, UK: Manchester University Press, 1969.

MIZRUCHI, M. S. Análise de redes sociais: avanços recentes e controvérsias atuais. *Revista de Administração de Empresas*, v.46, n.3, p.72-86, 2006.

MORENO, J. L. *Who shall survive? A new approach to the problem of human interrelations*. Washington, DC: Nervous and Mental Disease Publishing Company, 1934.

MUELLER, S. P. M. *Políticas de fomento à consolidação da capacidade de pesquisa no Brasil: Estudo para avaliação do Programa Pós-Doutoral no exterior mantido pela CAPES*. (2004). Relatório de pesquisa em andamento. Universidade de Brasília, 2004.

NEWMAN, M. E. J. *Coauthorship networks and patterns of scientific collaboration*. Proceedings of the National Academy of Sciences of the United States of America. Washington, v.101,n.1, p.5200-5205, 2004.

NOOY, W.; MRVAR, A.; BATAGEL, J. *Exploratory Network Analysis with Pajek. University Press*, New York, 2005.

PINTO, A. L.; EFRAIN-GARCÍA, P.; BARQUIN, B. A. R.; GONZALEZ, J. A. M. Scientific indicators on literature in bibliometry and scientometry through social networks, Brazilian *Journal of Information Science - BJIS*, v.1, n.1, p.55-73, 2007.

PRYKE, S. *Social network analysis in construction*. Chichester : Wiley-Blackwell, 2012.

RAUPP, F. M.; BEUREN, I. M. *Metodologia da pesquisa aplicável às ciências sociais*. In: BEUREN, I. M. (Org.). Como elaborar trabalhos monográficos em contabilida- de: teoria e prática. 3.ed. São Paulo: Atlas, 76-97, 2003.

RECUERO, R. Contribuições da Análise de Redes Sociais para o Estudo das Redes Sociais na Internet: O caso da hashtag #Tamojuntodilma e #CalaabocaDilma. *Revista Fronteiras*, v.16, n.2, p.60-67, 2014.

RECUERO, R. Comunidades em redes sociais na Internet: um estudo de caso dos fotologs brasileiros. *Liinc em Revista*, 4,63-83, 2008.

RIBEIRO, H. C. M. Produção Acadêmica da Área Temática Mercados Financeiro, de Crédito e de Capitais (MFC) divulgada no ANPCONT de 2007 A 2016. *Revista Evidenciação Contábil & Finanças*, 5, 75-93, 2017.

ROSA, L. M.; SILVA, A. M. F.; PEREIRA, R. S. M. R.; SANTOS S. M. A.; MEIRELLES, B. H. S. Família, Cultura e Práticas de Saúde: Um Estudo Bibliométrico. *Revista Enfermagem UERJ*. v.17, n.4, p.516- 520, 2009.

ROSSONI, L.; GUARIDO FILHO, E. R. Cooperação Entre Programas de Pós-graduação em Administração no Brasil: Evidências Estruturais em Quatro Áreas Temáti- cas. *Revista de Administração Contemporânea*, v.13, n.3, p.366-390, 2009.

SACOMANO NETO, M.; TRUZZI, O. M. S. Configurações Estruturais e Relacionais da Rede de Fornecedores: Uma Resenha Compreensiva. *Revista Administração*. v.39, n.3, p.255-263, 2004.

SÁ-SILVA, J. R.; ALMEIDA, C. D.; GUINDANI, J. F. Pesquisa documental: pistas teóricas e metodológicas. *Rev Bras Hist Cien Soc*. v.1, n.1, p.1-14, 2009.

SCOTT, J.; TALLIA, A.; CROSSON, C. J.; ORZANO, A. J.; STROEBEL, C. L. Social network analysis as an analytic tool for interaction patterns in primary care practices. *Annals of Family Medicine*, v.3, n.5, p.443–448, 2005.

SILVA, A. B. O.; MATHEUS, R. F.; PARREIRAS, F. S.; PARREIRAS, T. A. S. Estudo da rede de co-autoria e da interdisciplinaridade na produção científica com base nos métodos de análise de redes sociais: avaliação do caso do programa de pós-graduação em ciência da informação – PPGCI/UFMG. Encontros Bibli: *Revista Eletrônica de Biblioteconomia e Ciência da Informação*. v. esp., p.179-194, 2006.

SILVA, A. B. D. O. E.; PARREIRAS, F. S.; MATHEUS, R. F.; PARREIRAS, T. S. Análise de redes sociais como metodologia de apoio para a discussão da interdisciplinaridade na ciência da informação. *Ciência da Informação*, v.35, n.1, p.72–93, 2006.

SILVA, A. O.; FRANÇA, A. L. D.; BELLINI, C. G. P.; SILVA, P. M.; ARAÚJO, W. J. Colaboração Entre Programas de Pós-Graduação Brasileiros em Ciência da Informação: Modelagem Baseada em Grafos. *Informação & Informação*, v. 17, n.3, p.1-22, 2012.

SILVA, J. P.; BOUSFIELD, A. B. S.; CARDOSO, L. H. A hipertensão arterial na mídia impressa: análise da revista Veja. *Psicologia e Saber Social*, Rio de Janeiro, v.2, n.2, p.191-203, 2013.

SONNENWALD, D. H. Scientific collaboration: A synthesis of challenges and strategies, Cronin B.,(ed). *Annual Review of Information Science and Technology*, 41. Medford NJ: Information Today, Inc., 2007.

VAZ, G. A. Construção dos Sociogramas e a Teoria dos Grafos. *Revista Brasileira de Psicodrama*, p.67–78, 2009.

VANZ, S. A. D. S. Redes Colaborativas nos Estudos Métricos de Ciência e Tecnologia. *Liinc em Revista*, Rio de Janeiro, v.9, n.1, p.171-180, 2013. WASSERMAN, S.; FAUST, K. *Social network analysis: methods and applications*. Cambridge: Cambridge University Press, 1994.

WELLMAN, B. Network analysis: from method and metaphor to theory and substance. In: WELLMAN, B.; BERKOWITZ, S. D. (Eds.). *Social Structures: A Network Approach*. New York: Cambridge University Press., 1988.