

Intentional research networks between professors from a Brazilian Nursing undergraduate course

Redes de pesquisa intencional entre professores de um curso de graduação em Enfermagem
Redes de investigación intencionales entre profesores de un curso de pregrado de Enfermería
Brasileña

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Abstract: Public availability of curricula and data about research projects are offering a new field for researchers' relations analysis and networks are an adequate tool to this purpose. Nevertheless, few studies have analyzed undergraduate Nursing courses that are not associated to Nursing graduate programs. This study assessed research intention networks among permanent Nursing professors from the undergraduate program of a Brazilian, federal and public institution, based on research groups registered on the National Council of Scientific and Technological Development (known as CNPq) and research projects registered on Lattes Platform. Research groups and curricula of all Professors (active or retired) were accessed and evaluated how these professors interact by different interaction networks, according to the intention of the research, based in different relations among professors, areas and institutions. It was observed non structured networks, with actors without connection, presence of "neglected" links, and possible inactive registration related to academic formation. The word cloud also showed that the words used most times are less informative about research themes. Network was effective on interpretation of interactions related to research intention when applied to an undergraduate course, highlighting many behavior patterns of the group and presented itself as an effective tool to plan and comprehend research intentions in one institution.

Keywords: social network analysis; research; nursing.

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Resumo: A disponibilidade pública de currículos e dados sobre projetos de pesquisa está oferecendo um novo campo para análise de relações entre pesquisadores e o uso de redes é uma ferramenta adequada para esse fim. No entanto, poucos estudos ainda têm analisado cursos de graduação em Enfermagem que não estão associadas a programas de pós-graduação em Enfermagem. Este estudo avaliou redes de intenção de pesquisa entre professores permanentes de um curso de graduação em Enfermagem de uma instituição brasileira, federal e pública, com base em grupos de pesquisa registrados no Conselho Nacional de Desenvolvimento Científico e Tecnológico (conhecido como CNPq) e projetos de pesquisa registrados na Plataforma Lattes. Os grupos de pesquisa e currículos de todos os professores (ativos ou aposentados) foram acessados e avaliados como esses professores interagem por diferentes redes de interação, de acordo com a intenção da pesquisa, baseada em diferentes relações como as entre professores, áreas e instituições. Observou-se redes não estruturadas, com atores sem conexão, presença de vínculos "negligenciados" e possíveis registros inativos relacionados à formação acadêmica. As nuvens de palavras também mostraram que as palavras usadas na maioria das vezes são pouco informativas sobre as temáticas de pesquisa. O uso de redes foi eficaz na interpretação das interações relacionadas à intenção de pesquisa quando aplicada a um curso de graduação, destacando muitos padrões de comportamento do grupo e se apresentou como uma ferramenta eficaz para planejar e compreender as intenções de pesquisa em uma unidade de ensino.

Palavras-chave: análise de redes sociais; pesquisa; enfermagem.

Resumen: La disponibilidad pública de currículos y datos sobre proyectos de investigación están ofreciendo un nuevo campo para el análisis de las relaciones de los investigadores y las redes son una herramienta adecuada para este propósito. Sin embargo, los estudios caídos han analizado las maldiciones de enfermería de pregrado que no están asociadas a los programas de posgrado de enfermería. Este estudio evaluó las redes de intención de investigación entre profesores permanentes de Enfermería del programa de pregrado de una institución brasileña, federal y pública, a partir de grupos de investigación registrados en el Consejo Nacional de Desarrollo Científico y Tecnológico (conocido como CNPq) y proyectos de investigación registrados en la Plataforma Lattes. Se accedió a los grupos de investigación y currículos de todos los profesores (activos o jubilados) y se evaluó cómo interactúan estos profesores mediante diferentes redes de interacción, según la intención de la investigación, basadas en diferentes relaciones entre profesores, áreas e instituciones. Se observaron redes no estructuradas, con actores sin conexión, presencia de enlaces "descuidados" y posible registro inactivo relacionado con la formación académica. La nube de palabras también mostró que las palabras utilizadas la mayoría de las veces son menos informativas sobre temas de investigación. La red fue efectiva en la interpretación de las interacciones relacionadas con la intención de investigación cuando se aplicó a un curso de pregrado, destacando muchos patrones de comportamiento del grupo y se presentó como una herramienta efectiva para planificar y comprender las intenciones de investigación.

Palabras clave: análisis de redes sociales; investigación; enfermería.

1 Introduction

Nowadays, the academic analysis of the production of a group or academic entity is calling attention, specially by quantity and quality valuation of production and evaluation of researcher's merits (KOCHHANN, 2021). This scenario repeats among Nursing undergraduate and graduate programs, yet with fewer attention to undergraduate courses (SILVA *et al.*, 2009; MENDONÇA *et al.*, 2018; FERREIRA; TAVARES; KEBIAN, 2018; GIACCHERO; MIASSO, 2016).

Studies about Brazilian Nursing teams don't approach research intentions and networks between researchers work groups. We consider "research intention" as a proposition of a research object that may or may not become a product, such as an article or a book or other academic productions. Those intentions can be evaluated by different means, like organization of research groups (formal or informal), production of research projects and interaction or intention of collaboration between researchers, professors and students (SOUSA *et al.*, 2019). Another important source of information available nowadays is the curriculum vitae of professionals. Internationally, many from these curriculums are grouped in free web platforms like ResearchGate, ORCID and others.

Lattes Platform is a public research curriculum vitae academic database widely used in Brazil. It comprehends researcher's academic history and interactions with scientific groups or institutions, as well as personal academic history, published articles, and other actions on education, research and extension (DIAS *et al.*, 2016). Lattes Platform is managed by the National Council for Scientific and Technological Development (CNPq) a federative organ and linked to the Department of Sciences, Technology, Innovation and Communication of Brazil. In addition, it is a public data platform.

Therefore, research projects and collaboration networks have great importance when demonstrating professors' interactions (such as research group leaders) and professionals from a study group for example, or even as evaluation tool of focus and inter-relation of research objects. A network can be defined as connection method visualization between at least two elements based in connection criteria. Thus, networks or social network analysis as a methodology is widely used for interaction analysis and allow diverse possibilities and actions to identify main actors, engaged in knowledge mediation processes and information flux, as well as bonds and criteria built in network development (MACHADO; IPIRANGA, 2013; LANDIM *et al.*, 2010; ANDRADE; DAVID, 2015; CAVALCANTE *et al.*, 2018). As an example of connection criteria between researchers is participating in a research group and sharing a research project. In this case, both criteria are good indicators on research intention. Additionally, these

relationships could be easily accessed by, for example, exploring the public data available from CNPq or Lattes Platform.

Based on that, this study evaluated research intentions network among professors of an undergraduate Nursing course, from a Brazilian, public and federal institution, based on CNPq registered research groups and Lattes Platform registered research projects.

2 Material e Methods

2.1 Local and study design

This is a descriptive, analytic and transversal study. It includes the evaluation of research intention networks from the undergraduate Nursing Course, College of Medicine, from the Federal University of Uberlândia (UFU), state of Minas Gerais, Brazil. This undergraduate course is public and offers double habilitation, as Nurse Bachelor and Licentiate. Its duration is 10 semesters, with 40 students admitted per semester, and a total of 300 to 400 enrolled students. Its beginning was in 1999. In March 2021, moment of data collection, there were 26 permanent or active headcount professors, and eight permanent retired professors.

2.2 Legal and ethical aspects

Data from Lattes Platform and research groups from CNPq from the permanent active or retired headcount Professors from the Nursing course were access and included. There were no professor exclusion criteria. Substitute Professors (not headcount or temporarily hired) were not evaluated since their contract are of short duration (maximum of two years) and in many cases they don't have their production associated to the studied institution. Projects that clearly declared being of education or extension were excluded from the analyses.

All professors have their names, curriculum link, admission date or retirement date available in the institution website (<http://www.famed.ufu.br/famed/equipe/corpo-docente>). Since all data is of public domain with no authorization needed to access it, there was no submission to the Research Ethics Committee with human beings. Even though all information is of public domain, data that could be considered negative or that could cause discomfort were not presented. These data are from professors whit no link to research projects or groups, or that were registered as students in research groups. These professors were not identified at any moment.

2.3 Data collection

Lattes Research Projects

Lattes curricula from all professors were accessed as well as their registered research projects (Lattes item as “Projetos de pesquisa” in portuguese). Data collection included title, participants, coordinator, coordinator affiliated institution, date of beginning and end of the project. All curricula were accessed between March 15th and 21st from 2021, and in the beginning of the 21st all curricula were double checked to verify any alterations. All curricula were accessed online at Lattes Platform (<http://lattes.cnpq.br/>) at the option search curricula “Buscar currículo in portuguese” (<http://buscatextual.cnpq.br/buscatextual/busca.do?metodo=apresentar>) or by the link available in the institutions website. The platform is of open survey, all data are public and inserted by the own researcher, that is, all information included is by their own responsibility. All projects dated beginning in the year of the Professors admission in the course until data collection date or retirement date were considered.

To each project, the following data were collected: title, starting and ending year, if in progress, name of affiliated institution of the project coordinator (in affiliation cases, curriculum from the coordinators was also accessed by the same platform), Nursing undergraduate course professors’ names associated to the project. Each project was evaluated only once, independently if present in more than one curriculum. To analyze research intention network only ongoing projects or that ended in 2021 were considered. Projects that ended in March 2021, that is, time of data collection, could still maintain remaining activities after the collection, and were still maintained in the present analysis.

CNPq Research Groups

The inclusion in registered research groups of CNPq was evaluated for each professor. This search was conducted in the open database CNPq Directory Research Group (“Grupo de Diretórios de Pesquisa do CNPq” in Portuguese) (<http://lattes.cnpq.br/web/dgp>) in the item Search Directory (“Pesquisar diretórios in portuguese”), in the parameterized online tool search, considering the professors name as search term (http://dgp.cnpq.br/dgp/faces/consulta/consulta_parametrizada.jsf). Current database (“Base de dados Corrente” in portuguese) (only to active groups), Researcher name (“Nome do Pesquisador” in Portuguese) and Student name (“Nome do estudante” in Portuguese) were used as search criteria. All professors’ names are available at the College of Medicine website (<http://www.famed.ufu.br/famed/equipe/corpo-docente>).

To each professor insert in a research group, data about this group was collected, such as: groups name, coordinators names, institution of the groups and registration area in CNPq, registration date and group function (Researcher or Student). Inactive registration in groups were not considered, and data from egresses were not collected. Professors were coded with their initials and the groups with a sequential code (G_1 to G_{esm}). To professors that changed their names or had incomplete names, the first name was maintained or the name in the institution's website. Professors' registration date in the group was then dichotomized as in until 2014 (assuming yes) or from 2015 on (assuming no), since the exact date is not available for those before 2014. Institutions were also categorized in work institution (in this case Federal University of Uberlândia, assuming yes) and other institutions (assuming no). This segmentation allowed better group representation to analyze associations. Since one research group was present in two different institutions with the same name, the institutions monogram was added to the group's name to differ.

No collected data was validated directly with the professors. Validation would demand direct approach to the professionals, and the present project aimed to work only with public information provided by themselves. Yet, many fulfillment mistakes were observed in Lattes, not all of them described in this article, such as lack of data and necessity of validation data between different professor's registrations of a same project.

Collaboration network

An electronic spreadsheet database was created with binary interactions of research and project groups. To both cases data was paired in the database. Three bipartite networks were created with research group data: research group and professors; CNPq registration area and professors; group coordinator institution and professors. Also, three bipartite networks were created with research project data: research project and professors; research project and professors, excluding projects with no collaboration among course professors; project coordinator institution and professors.

Word cloud

All monograms, symbols, pronouns, articles, prepositions and conjunction were excluded from the corpus (projects titles) to build the word cloud with the names of the groups and projects. All titles were automatically translated by an online translator (<https://www.bing.com/translator>). The translation was not modified. All words were kept in singular. Words with no research connotation obtained by research groups were also removed (*research, study, group, laboratory, center*), since they had no relation to the research group purpose. This exclusion did not happen to the projects since the corpus was more complex and difficult to identify these words with no

relation to the projects. The word cloud was implemented in R with the packages tm, SnowballC, wordcloud and RColorBrewer.

2.4 Statistical analyses

The dependency from dichotomized time of admission, affiliation and area from groups with the function of professor in the group (student or researcher) was tested with Fisher's Exact Test. For the prediction of the group function (student as considered the event of interest) the data of predictor variables (admission time and area, both dichotomized) were adjusted to multiple logistic regression models. The Odds-Ratio and their 95% confidence interval (95%CI) were also calculated. The backward criteria of selection were used adopting the probability of Wald greater than 0.05 as exclusion criteria.

For all analyses, the data were analyzed in the R environment. A significance of 5% was adopted for all analyses. The networks were constructed with the packages igraph (CSARDI; NEPUSZ, 2006) and bipartite (DORMANN; GRUBER; FRUEND *et al.*, 2008).

2.5 Results

Twenty-five research groups were identified in the CNPq Directory Research Group, of four areas: Botany, Nursing, Medicine and Public Health. Seven institutions were affiliated: Federal University of Catalão, Goiás state (UFCAT; 4.00%, 1 of 25 groups); Federal University of Goiás, Goiás state (UFG; 4.00%, 1 of 25 groups); State University of Campinas, São Paulo state (UNICAMP; 4.00%, 1 of 25 groups); Federal University of São Paulo, São Paulo state (UNIFESP; 4.00%, 1 of 25 groups); Federal University of Triângulo Mineiro, Minas Gerais state (UFTM; 24.00%, 6 of 25 groups); University of São Paulo, São Paulo state (USP; 32.00%, 8 of 25 groups); and UFU (28.00%, 7 of 25 groups) (Table 1). Among the professors that had no registration in the directory, three were active and five were inactive (retired).

Table 1 - Research groups between professors in a Brazilian Nursing Undergraduate course in March of 2021 in CNPq database (Brazilian National Council for Scientific and Technological Development - CNPq, in Portuguese: Conselho Nacional de Desenvolvimento Científico e Tecnológico)

CNPq research group names (translated from Portuguese)	Area	Institution¹	Code
Comprehensive Child and Adolescent Health Care - AISCA	Nursing	UFU	G1
Botany-UFU	Botany	UFU	G2
Nursing and women's health	Nursing	UFTM	G3
Spirituality and Cardiology: Interprofessional Approach - UFCAT	Medicine	UFCAT	G4
Spirituality and Cardiology: Interprofessional Approach - UFG	Medicine	UFG	G5
GIPHA - Interdisciplinary Research Group on Hypertension	Nursing	USP	G6
Study group on the rehabilitation of surgical and oncologic patients	Nursing	USP	G7
Study Group on Prevention of Harmful Use of Alcohol and/or Drugs - GRUPAD	Nursing	USP	G8
Study group and research in evidence-based practice and patient safety in the care process	Nursing	UFTM	G9
Study group and research on the use of human resources in nursing	Nursing	USP	G10
Study group on mental health and its interfaces with other chronic conditions - GESMIC	Public Health	UFU	G11
Research group on rehabilitation and quality of life	Nursing	USP	G12
Cardiovascular Health Research Group	Nursing	UFU	G13
Collective Health Research Group	Public Health	UFTM	G14
Advanced Laboratory in Gender and Violence Studies	Nursing	UFU	G15
Laboratory of studies and research in suicide prevention and posvention (LEPS)	Nursing	USP	G16

Emergency League in Nursing- LUREEN	Nursing	UFU	G17
Center for Study and Research in Epidemiology and Quantitative Methods in Health	Public Health	UFTM	G18
Center for Studies of Prevention and Infection Control in Health Services (NEPECISS)	Nursing	USP	G19
Center for studies on psychiatric disorders: care and research - NUDPAS	Nursing	USP	G20
Research Center in Education, Nursing and Health	Nursing	UFU	G21
General Pathological Processes and Infectious and Parasitic Diseases	Medicine	UFTM	G22
Women's and Newborn Health	Nursing	UNICAMP	G23
Safety, Technology and Care (SEGTEC) - Nursing research group on patient safety, pediatric intensive care and intravenous and drug therapy	Nursing	UNIFESP	G24
Adult Living and Health	Nursing	UFTM	G25

¹ Institution name abbreviation adopted by Brazilian federal institutions

Source: prepared by the authors (2022)

Fifty-one Nursing professors from UFU were registered in research groups. Registrations in Nursing area had only 12.50% of students (5 in 40 registrations), while other areas have 18.18% (2 in 11 registrations), with no difference between the two groups (Fisher's Exact Test $p = 0.635$). Registrations from other units outside UFU had 33.33% of students registered (7 in 21 registrations). When only UFU registrations were evaluated, 100% (30 in 30) are classified as researcher.

Evaluating the admission time until 2014, showed that 42.85% of registers are classified as students (6 in 14 registrations). From 2015 on, only 2.70% are students (1 in 3 registrations), with statistical difference between groups (Fisher's Exact Test $p = 0.001$). Only admission time was able to predict professors role in the group as student (constant = -3.584; $p < 0.001$; $B1 = 3.296$; $p = 0.004$), that is, being admitted until 2014 leads to a 27 times higher chance that the registration was done as a student (*Odds Ratio* = 27.00, *95%CI*: 2.84, 256.51).

These findings support the hypothesis that these registrations can be associated to previous bounds before professor's admission, since registrations are associated to

Four institutions were connected to only one professor (UNICAMP, UFCAT, UFG e UNIFESP), and one of them did not connect to UFU (Figure 1C, Table 2).

Table 2 - Descriptive network metrics observed between professors in a Brazilian Nursing Undergraduate course in March of 2021 based on research group database from CNPq and research projects from Lattes database.

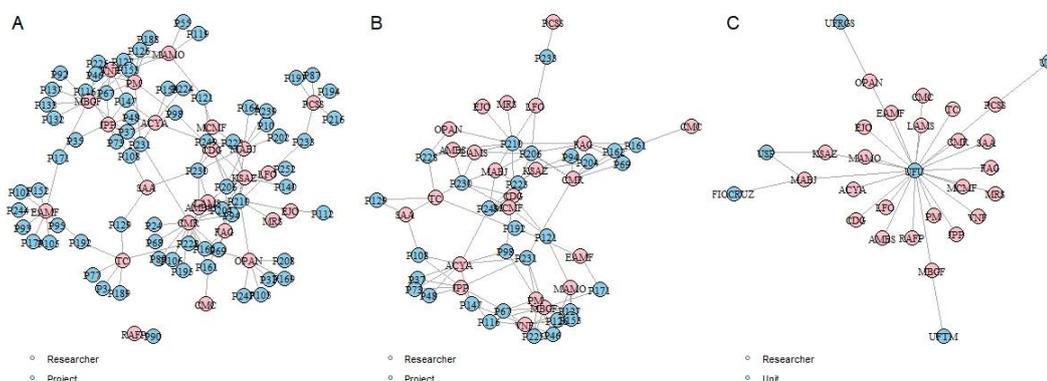
Statistic	Connectors					
	Research groups			Research projects		
	Group	Area	Affiliation	All Projects	Project with collaboration	Affiliation
n professors	24	24	24	24	23	24
n groups	25	-	-	-	-	-
n projects	-	-	-	72	30	-
n areas	-	4	-	-	-	-
n affiliation	-	-	7	-	-	6
n links	51	51	51	146	104	146
Minimum aresta professor	1	1	1	1	1	1
Maximum aresta professor	5	4	2	13	8	3
Minimum aresta connector	1	1	1	1	2	1
Maximum aresta connector	12	18	22	11	11	24

Source: prepared by the authors (2022).

The majority of Lattes research projects network are associated to only one professor, 42 projects have no collaboration and 30 have collaboration of the course professors (Figure 2A, Table 2), and one professor was linked to only one project. Another analysis, excluding projects with no collaboration among Nursing professors of UFU, was done to provide a better visualization of connections. Most professors were connected to the network and only a few of them were connected to only one aresta (Figure 2B, Table 2). Most connections of professor with project coordinators affiliation were relative to UFU, while the remaining affiliations presented few arestas (Figure 2B, Table 2).

Two active professors had no connection to any CNPq research group. One retired professor maintained active registration in research groups. Two active professors had no registration to any research project in Lattes, and no retired professor had ongoing projects. Professors with no connection were not plotted in any network.

Figure 2 - Professors from Federal University of Uberlândia (UFU) Nursing under graduation Course from interaction network, obtained from Lattes registered research projects and ongoing projects. A. based on all active or that ended in 2021 projects. B. based on previous projects excluding the projects without collaboration with other nursing professor of UFU. C. based on institution coordinator affiliation.



Source: prepared by the authors.

CNPq research group corpus obtained 98 observations distributed in 66 words. The 15th most cited were: health (9); care (5); nursing (5); patient (3); prevention (3); safety (3); women (2); spirituality (2); cardiology (2); interprofessional (2); approach (2); rehabilitation (2); drug (2); process (2) and infection (2) (Figure 3A). Lattes research project corpus obtained 655 observations distributed in 351 words. The 17th most cited were: health (18); patient (16); care (15); university (11); nursing (10); women (9); clinical (8); hospital (8); study (8); unit (7); safety (7); service (7); family (6); use (6); student (6); public (6) and perception (6) (Figure 3B).

collaborations inside the research institution. Independently, groups and actors were already highlighted, and in some cases assume more than one pattern in different networks, even though other variables and more reliable data (validated, since some inconsistencies were observed between curricula) should be approached to network construction. Similar behavior to the observed here highlights isolated actors and the formation of few collaboration groups (SILVA *et al.*, 2006).

Neglected links are evident in the interaction between professors and affiliations that were distinct between research groups and projects. Possibly, the groups bidding is previous than the projects and reflect each professor's formation history, although it was observed some projects bounded to institutions and with no bound to any research group in the same institution. These findings emphasize that projects or groups are more related to the research intention, since even though some professors are bounded to a research group of an institution, the same professors do not have any research project bounded to that institution, or vice versa. It is important to notice that a research project bounded to a research group may be from authorship of an UFUs professor as a coordinator, and that the coordinator may not register the collaborator institution, by that losing the intention.

It was not possible to bind all the actors of the projects and the research groups, since in most curricula authors were not identified (the authors name linked to the respective Lattes curricula). Previous orientation and research relations are common in networks (SILVA; MARTINS, 2016; NOGUEIRA; SILVA, 2017). We infer that many group bonds are long standing and related to the Professors formation in Doctorate and Post-Doctorate programs, and that they are not ongoing in some cases. In some cases, this speculation is strengthened by the former registration in the research group and in the condition of student and absence of ongoing research projects with the group or in the theme.

The present study brings to discussion the "quantitative stress", concerning the high pressure to produce among professors and researchers (MEIS *et al.*, 2003), that are constantly evaluated by bibliographic production metrics. In the Brazilian system these evaluation indicators metrics have the capability of validate and classify research groups or institutions, rebounding classification systems and international rankings in a global scope that includes Nursing (SCOCHI *et al.*, 2013; NOBRE; FREITAS, 2017). In contrast, the products are measured and classified, but the generation process of the products still remains unknown in most times (OECD, 2011). Thus, many times actors see themselves obligated to collaborate or change their collaboration methods to enhance their productivity, regardless the knowledge of the theme and even other ethical aspects (SANTOS; RABELO, 2017). In this context, it is important to comprehend how the research intention is structured and subsequently evaluate how it actually converts into a research product and the research relations in the future.

The exponent increase of works with collaboration and facility of access to its metadata makes the professors production and research group networks analysis assist the comprehension of interpersonal relations (DIAS, T.; MOITA; DIAS, P., 2019), likewise the ones observed in this study. These networks can be heterogeneous, not dense and with minimum medium paths relatively low, and, by analyzing publication titles, regional expressions are highlight by its frequency in the word cloud (DIGIAMPIETRI, 2015). The word clouds we have here are little informative and do not reflect very much about the studied themes. Alternatively, the projects could be categorized in research areas in future studies.

When analyzing the research theme (or research line), it was verified that education elements of Nursing Administration were linked to other themes, especially those related to management, education, politics and work, which supports that the technique application in more specific themes, lines or areas can present more informative results, even arising more generic words (FIGUEREDO; MACEDO, 2020). Majority of occurrence of non-informative words have been observed in Nursing abstracts on thesis and dissertations, being the five most common words: Nursing, Nurse, data, study, and patient (AMORIM *et al.*, 2020). These finding are similar to the observed here, and emphasizes that the most common words health, care, Nursing, patient and university are little informative about the theme, actuation area or focus of the projects.

Lattes Platform and research groups registered in CNPq database are the main open access tool, at least in Brazil, to researchers' data and their production in various areas, due to its easy access (DIAS, T.; MOITA; DIAS, P., 2019; BRITO; QUONIAM; MENA-CHALCO, 2016). The present study used public data in those databases to establish the dynamic relation and evaluate research intentions. We highlight the importance of using other techniques and databases already described in literature to the same purpose, such as predicting link loss technique which evaluates the presence or absence of the researcher in determined group, with the model "Support Vector Machines (SVM)" (PEREZ-CERVANTES *et al.*, 2013). To determine which researcher is more "productive", "collaborative", "influent" and that can be an essential actor in the collaboration process is an important aspect, however, that can be a form of duress, pressure and stress to enhance productivity and collaboration. Those techniques must be used to strengthen the group, emphasize points that can be worked and not only as an evaluation metric or to discriminate a professor before another one.

3.1 Limitations

The impossibility to evaluate if there are errors in completing curriculum or lack of filling data is one limitation of this study. Data depends only in the adequate filling of Lattes, by the own researcher. Some possible filling mistakes were identified in Professor's curricula but were not evaluated or checked here by method restrictions. The inadequate use of Lattes has also limited our evaluation execution in a more precise manner.

4 Conclusions

Application of the network theory in CNPq research groups and Lattes registered projects in a Nursing undergraduate Course was effective in demonstrating the relations between the unit professors in different perspectives. This methodology was able to highlight fragilities (isolated actors, actors with few links, neglected links) and strengths (well-connected actors, low frequency of actors without interactions) of the relations in the research intentions of the group. These results can provide basis to future research stimuli policies to the Professors investigated.

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References

AMORIM, I. G.; MORAIS, R. O. B.; AMORIM, É. G.; MEDEIROS NETA, O. M.; BESERRA, P. J. F.; SOUSA, A.S.; MENDONÇA, A. E. O. Caracterização das teses e dissertações brasileiras na área de Enfermagem em Unidade de Terapia Intensiva. **Research, Society and Development**, Vargem Grande Paulista, v.9, n. 8, e937986626-e937986626, 2020. DOI: 10.33448/rsd-v9i8.6626. Disponível em: <https://rsdjournal.org/index.php/rsd/article/view/6626>. Acesso em: 20 abr. 2022.

ANDRADE, D. M. C.; DAVID, H. M. S. L. Análise de redes sociais: uma proposta metodológica para a pesquisa em saúde e na enfermagem. **Revista Enfermagem UERJ**, Rio de Janeiro, v. 23, n. 6, p. 852-855, fev. 2015. DOI: 10.12957/reuerj.2015.14861. Disponível em: <https://www.e-publicacoes.uerj.br/index.php/enfermagemuerj/article/view/14861/16204>. Acesso em: 20 abr. 2022.

BRITO, A. G. C. D.; QUONIAM, L.; MENA-CHALCO, J. P. Exploração da Plataforma Lattes por assunto: proposta de metodologia. **Transinformação**, Campinas, SP, v. 28, n. 1, p. 77-86, 2016. DOI: <https://doi.org/10.1590/2318-08892016002800006>. Disponível em: <https://www.scielo.br/j/tinf/a/P3CJs6ms3HsTbQxsQKqKYps/?lang=pt>. Acesso em: 20 abr. 2022.

CAVALCANTE, J. B.; SILVA-JUNIOR, G. B.; BASTOS, M. L. A.; COSTA, M. E. M.; SANTOS, A. L.; MACIEL, R. H. M. O. Rede de relações em um serviço de atendimento móvel de urgência: análise de uma equipe de trabalho. **Revista Brasileira Medicina do Trabalho**, São Paulo, SP, v. 16, n. 2, p. 158-166, 2018. DOI: 10.5327/Z1679443520180208. Disponível em: <http://www.rbmt.org.br/details/311/pt-BR/rede-de-relacoes-em-um-servico-de-atendimento-movel-de-urgencia--analise-de-uma-equipe-de-trabalho>. Acesso em: 20 abr. 2022.

CSARDI, G.; NEPUSZ, T. The igraph software package for complex network research. **InterJournal Complex Systems**, [s.l.], v. 1695, 2006. Disponível em: https://www.researchgate.net/publication/221995787_The_Igraph_Software_Package_for_Complex_Network_Research. Acesso em: 20 abr. 2022.

DIAS, T. M. R.; MOITA, G. F.; DIAS, P. M. Um estudo sobre a rede de colaboração científica dos pesquisadores brasileiros com currículos cadastrados na Plataforma Lattes. **Em Questão**, Porto Alegre, v. 25, n. 1, p. 63-86, 2019. DOI: 10.19132/1808-5245251.83-86. Disponível em: <https://seer.ufrgs.br/EmQuestao/article/view/81536>. Acesso em: 20 abr. 2022.

DIAS, T. M. R.; MOITA, G. F.; DIAS, P. M. Adoption of the lattes platform as the data source for the characterization of scientific networks. **Encontros Bibli: Revista Eletrônica de Biblioteconomia e Ciência da Informação**, Florianópolis, SC, v. 21, n. 47, p. 16-26, 2016. DOI: 10.5007/1518-2924.2016v21n47p16. Disponível em: <https://periodicos.ufsc.br/index.php/eb/article/view/1518-2924.2016v21n47p16>. Acesso em: 20 abr. 2022.

DIGIAMPIETRI, L. **Análise da rede social acadêmica brasileira**. 2015. Monografia (Livre Docência) - Escola de Artes Ciências e Humanidades da Universidade de São Paulo, São Paulo, 2015.

DORMANN, C. F.; GRUBER, B.; FRUEND, J. Introducing the bipartite Package: analyzing ecological networks. **R. News**, Göttingen, v. 8, n. 2, p. 8-11, 2008. Disponível em: https://uni-goettingen.de/de/document/download/96729eb9d30a6f2dc4403df15854305c.pdf/Rnews2008.8.8-11_open.pdf. Acesso em: 15 abr. 2022.

FERREIRA, R. E.; TAVARES, C. M. M.; KEBIAN, L. V. A. Produção científica relacionada ao mestrado profissional em enfermagem Scientific production related to the professional master in nursing. **Revista de enfermagem UFPE on line**, Recife, v. 12, n. 3, p. 763-771, 2018. DOI: 0000-0003-2159-543X. Disponível em: <https://periodicos.ufpe.br/revistas/revistaenfermagem/article/view/230612/28044>. Acesso em: 20 abr. 2022.

FIGUEREDO, W. N.; MACÊDO, T. T. S. Panorama do ensino de administração na pós-graduação em enfermagem no Brasil. **RAHIS-Revista de Administração Hospitalar e Inovação em Saúde**, Belo Horizonte, v. 17, n. 2, p. 115-124, 2020. DOI: 10.21450/rahis.v17i2.6216. Disponível em: <https://revistas.face.ufmg.br/index.php/rahis/article/view/6216>. Acesso em: 20 abr. 2022.

GIACCHERO, K.G.; MIASSO, A. I. A produção científica na graduação em enfermagem (1997 a 2004): análise crítica. **Revista eletrônica de enfermagem**, Goiânia, v. 8, n. 3, p. 431-40, 2006. DOI: 10.5216/ree.v8i3.7082. Disponível em: <https://revistas.ufg.br/fen/article/view/7082/5013>. Acesso em: 20 abr. 2022.

GUIMARÃES, T. A.; GOMES, A. O.; ODELIUS, C. C.; ZANCAN, C.; CORRADI, A. A. A rede de programas de pós-graduação em administração no Brasil: análise de relações acadêmicas e atributos de programas. **Revista de Administração Contemporânea**, Maringá, v. 13, n. 4, p. 564-582, 2009. DOI: 10.1590/S1415-65552009000400004. Disponível em: <https://www.scielo.br/j/rac/a/ntfjvQTZcB4xX4zyb7cYLbB/?lang=pt>. Acesso em: 20 abr. 2022.

KOCHHANN, A. **A produção acadêmica e a construção do conhecimento científico: concepções, sentidos e construções**. Goiânia: Kelps, 2021.

LANDIM, F. L. P.; FERNANDES, A. M.; MESQUITA, R. B.; COLLARES, P. M. C.; FROTA, M. A. Análise das redes interpessoais: aplicação na realidade de uma equipe de enfermagem atuando em unidade de hematologia. **Saúde e sociedade**, São Paulo, v. 19, n. 4, p. 828-827, 2010. DOI: 10.1590/S0104-12902010000400010. Disponível em: <https://www.scielo.br/j/sausoc/a/dvh4KM4HFrczjzjQMLPhSq/?lang=pt>. Acesso em: 20 abr. 2022.

MACHADO, D. D. Q.; IPIRANGA, A. S. R. Characteristics and performance of knowledge networks in the biotechnology sector. **Revista de Administração Contemporânea**, Maringá, v. 17, n. 3, p. 350-367, 2013. DOI: 10.1590/S1415-65552013000300006. Disponível em: <https://www.scielo.br/j/rac/a/GYr8qcCWJyp8YNDpgJNc8MD/?lang=en>. Acesso em: 20 abr. 2022.

MEIS, L.; VELLOSO, A.; LANNES, D.; CARMO, M. S.; MEIS, C. The growing competition in Brazilian science: rites of passage, stress and burnout. **Brazilian Journal of Medical and Biological Research**, Ribeirão Preto, v. 36, n. 9, p. 1135-1141, 2003. DOI: 10.1590/S0100-879X2003000900001. Disponível em: <https://www.scielo.br/j/bjmr/a/X9Fby6spKPD7B9mt4PcSHsF/?lang=en>. Acesso em: 20 abr. 2022.

MENDONÇA, G. M. M. M.; CESTARI, V. R. F.; RODRIGUES, L. N.; SAMAPIO, M. O. M.; FREITAS, M. C.; GUEDES, M. V. C. Produção científica de egressos de um programa de pós-graduação em enfermagem. **Revista de Pesquisa Cuidado é Fundamental Online**, Rio de Janeiro, RJ, v. 10, n. 2, p. 485-489, 2018. DOI: 10.9789/2175-5361.2018.v10i2.485-489. Disponível em: http://seer.unirio.br/cuidadofundamental/article/view/6105/pdf_1. Acesso em: 20 abr. 2022.

NOBRE, L. N.; FREITAS, R. R. A evolução da pós-graduação no Brasil: histórico, políticas e avaliação. **Brazilian Journal of Production Engineering - BJPE**, São Mateus, v. 3, n. 2, p. 26-39, 2017. DOI: 10.0001/v3n2_3. Disponível em: https://periodicos.ufes.br/bjpe/article/view/v3n2_3/pdf. Acesso em: 20 abr. 2022.

NOGUEIRA, E.; SILVA, H. Colaboração científica na Ciência da Informação: uma análise dos periódicos "Em Questão" e "Informação & Informação". **Biblionline**, João Pessoa, v. 13, n. 55, 2017. DOI: 10.22478/ufpb.1809-4775.2017v13n3.35208. Disponível em: <https://periodicos.ufpb.br/index.php/biblio/article/view/35208>. Acesso em: 20 abr. 2022.

OECD. OECD Global Science Forum. Opportunities, challenges and good practices in international research cooperation between developed and developing countries. Paris: OECD-GSF, 2011. Disponível em: <https://www.oecd.org/sti/inno/47737209.pdf>. Acesso em: 15 abr. 2022.

PEREZ-CERVANTES, E.; MENA-CHALCO, J. P.; OLIVEIRA, M. C. F.; CESAR, R. M. Using link prediction to estimate the collaborative influence of researchers. In: IEEE international conference on eScience, 9., 2013, Beijin. **Anais** [...]. Beijin: IEEE, 2013. p. 293-300. DOI: 10.1109/eScience.2013.32.

ROSSONI, L.; HOCAYEN-DA-SILVA, A. J.; FERREIRA JÚNIOR, I. Aspectos estruturais da cooperação entre pesquisadores no campo de administração pública e gestão social: análise das redes entre instituições no Brasil. **Revista de Administração Pública**, Rio de Janeiro, v. 42, n. 6, p. 1041-1067, 2008. DOI: 10.1590/S0034-76122008000600002. Disponível em: <https://www.scielo.br/j/rap/a/nBfDQRgYWSqWHNm8M3Xd5wz/?lang=pt>. Acesso em: 22 abr. 2022.

SANTOS, L. R.; RABELO, D. M. R S. Produção científica: avaliação, ferramentas e indicadores de qualidade. **Ponto de Acesso**, Salvador, v. 11, n. 2, p. 3-33, 2017. DOI: 10.9771/rpa.v11i2.13698. Disponível em:

<https://periodicos.ufba.br/index.php/revistaici/article/view/13698>. Acesso em: 20 abr. 2022.

SCOCHI, C. G. S.; MUNARI, D. B.; GELBCKE, F. L.; ERDMANN, A. L.; GUTIÉRREZ, M. G. R. D.; RODRIGUES, R. A. P. Pós-graduação Stricto Sensu em Enfermagem no Brasil: avanços e perspectivas. **Revista Brasileira de Enfermagem**, Brasília, 66(spe), p. 80-89, 2013. DOI: 10.1590/S0034-71672013000700011. Disponível em:

<https://www.scielo.br/j/reben/a/tZgBghmWwXKsFx3ZFYbgFwn/?format=pdf&lang=pt>.

Acesso em: 20 abr. 2022.

SILVA, A. B. O; MATHEUS, R. F.; PARREIRAS, F. S.; PARREIRAS, T. A. S. Análise de redes sociais como metodologia de apoio para a discussão da interdisciplinaridade na ciência da informação. **Ciência da Informação**, Brasília, v. 35, n. 1, p. 72-93, 2006. DOI: 10.1590/S0100-19652006000100009. Disponível em:

<https://www.scielo.br/j/ci/a/WWpWjQYnfDnb6PH8sQbzVMn/?lang=pt>. Acesso em: 15 abr. 2022.

SILVA, E. A.; MARTINS, D. L. Rede de coautoria da Universidade Federal de Goiás: o impacto de publicações internacionais. **AtoZ: novas práticas em informação e conhecimento**, [Curitiba], v. 5, n. 2, p. 91-103, 2016. DOI: 10.5380/atoz.v5i2.47854. Disponível em:

<https://revistas.ufpr.br/atoz/article/view/47854/30164>. Acesso em: 15 abr. 2022.

SILVA, V.; HOLZMANN, A. P. F.; VERSIANI, C. C.; FIGUEIREDO, M. F. S.; LIMA, A. C. A. S.; VIEIRA, M. A.; SENA, R. R. Análise dos trabalhos de conclusão de curso da graduação em enfermagem da UNIMONTES. **Revista eletrônica de enfermagem**, Goiânia, v. 11, n. 1, p. 133-43, 2009. DOI: 10.5216/ree.v11i46897. Disponível em: <https://revistas.ufg.br/fen/article/view/46897>.

Acesso em: 15 abr. 2022.

SOUSA, E. S.; FONTENELE, R. E. S.; SILVA, A. L. L.; SOUSA FILHO, J. M. Mapeamento da produção científica internacional sobre intenção empreendedora. **Revista de Gestão e Secretariado**, [Curitiba], v. 10, n. 3, p. 114-139, 2019. DOI: 10.7769/gesec.v10i3.901.

Disponível em: <https://ojs.revistagesec.org.br/secretariado/article/view/901>. Acesso em: 15 abr. 2022.

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Maria Beatriz Guimarães Raponi – Analysis of results; writing and final revision of the text.

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