Exploring Interoperability Between Local and Global Databases in Scientometrics: Lattes, Capes, and OpenAlex

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Exploring Interoperability Between Local and Global Databases in Scientometrics: Lattes, Capes, and OpenAlex

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Abstract: Numerous initiatives are currently underway to disambiguate databases worldwide. In this paper, we propose a methodology for disambiguating research entities using big data techniques, adopting an approach that goes from local to global databases. Our objective is to enhance the quality of data in the OpenAlex database by leveraging information from Brazilian databases, particularly data from the Lattes Platform and the Brazilian Federal Agency for Support and Evaluation of Graduate Education. We compare similar names of authors and institutions, employing Digital Object Identifiers to link entities, along with an adaptation of the Levenshtein distance algorithm. The proposed method is straightforward to implement in tabular databases and facilitates disambiguation, thereby contributing to open science practices and providing an effective solution for research information systems. The findings indicate the potential for integrating local and global databases to address issues related to ambiguous names and incomplete metadata.

Keywords: Bibliographic coverage, Lattes CV, Scientometrics.

1. Introduction

There are several research entity disambiguation systems and algorithms (Ferreira et al., 2012; Levin et al., 2012; Sanyal et al., 2021; Xu et al., 2018). These systems are typically employed within research information frameworks to facilitate scientometric studies. In commercial databases such as Scopus (Boyle & Sherman, 2006), authors are required to input their data, which results in the creation and maintenance of a persistent identifier. This process is designed to ensure the disambiguation of authors and institutions. However, the references cited are not always included in the input, and their metadata often lacks proper disambiguation. The curation of this data is essential for its effective use; however, much of this information remains obscured as a commercial product within vendors' platforms (Mongeon & Paul-Hus, 2016).

The recent efforts to develop comprehensive research information databases, such as DataCite, OpenAlex, and OpenAIRE, aim to address this issue by employing several advanced matching algorithms, many of which are based on machine learning (Kim & Kim, 2018; Qian et al., 2011; Rehs, 2021). However, these approaches have certain limitations, primarily due to coverage issues that can result in incorrect identifications (Rehs, 2021).

The analysis of research data in digital repositories presents an increasing challenge that encompasses various aspects, with author name ambiguity remaining a persistent issue. This ambiguity can significantly affect the performance of document retrieval through web search engines and undermine the integrity of entities within integrated databases. In Latin America, some researchers have examined the use of Digital Object Identifiers (DOIs) in the cited references of Brazilian institutions (Mugnaini et al., 2021) and investigated various methods for author name disambiguation in bibliographic repositories, including the Levenshtein distance algorithm (De Souza Rodrigues et al., 2021). However, we have not identified an approach that effectively integrates DOIs with the Levenshtein distance algorithm for this purpose.

Global databases, such as OpenAlex, are valuable resources (Barrett, 2023), but local databases can significantly enhance the metadata of these global sources. In this context, our objective is to enhance the quality of data in the OpenAlex database by utilizing the Lattes Platform, along with information from the Coordination for the Improvement of Higher Education Personnel (Capes), which serves as Brazil's national researcher registry. The novelty of this study lies in an effective methodology for matching research entities to disambiguate them within both local and global research information databases. To achieve this, a big data approach employs persistent identifiers, with a particular emphasis on DOIs, as well as connections between entities, such as co-authorships. The information is then integrated using an adapted Levenshtein distance algorithm for authors.

It is highly likely, as demonstrated in this study, that projecting the content of these databases onto local scientific databases can effectively address issues related to ambiguous names and the lack of persistent identifiers. We utilized the Lattes database (Mena-Chalco & Junior, 2009) as a foundation to cross-reference its outputs with OpenAlex for authors. The same was done when considering the Capes database for institutions when testing against OpenAlex.

Achieving a nearly complete match of researchers, institutions, and publications would facilitate bibliometric research across the Lattes database. This integration will also enhance the OpenAlex database by broadening its coverage and improving the quality of its metadata. The results demonstrate high precision and ease of implementation, making it particularly well-suited for tabular databases, which are commonly used in research information systems.

2. Lattes database

In the late 1990s, Brazil's national funding agency recognized the necessity for a new approach to evaluating researchers' credentials. To address this need, it established a 'virtual community' that included federal agencies and researchers, tasked with designing and developing the Lattes infrastructure. This comprehensive database offers high-quality data on millions of researchers and thousands of registered institutions. According to Lane (2010), the Brazilian experience with the Lattes Database (http://lattes.cnpq.br) serves as a model for best practices in research assessment, fostering appropriate incentives for both researchers and academic institutions to engage with the database. As discussed by Sidone et al. (2017), Lattes facilitates classification across eight research fields: i) Agricultural Sciences; ii) Human Sciences; iii) Biological Sciences; iv) Health Sciences; v) Engineering; vi) Applied Social Sciences; vii) Exact and Earth Sciences; viii) Linguistics, Letters, and Arts; and ix) others.

3. Capes open data initiative

In the context of Brazilian higher education, the Coordination for the Improvement of Higher Education Personnel (CAPES) plays a crucial role. Established in 1951, CAPES has become a federal agency responsible for supporting and evaluating postgraduate education in Brazil. The literature generally recognizes 1976 as a milestone year for the country's postgraduate evaluation system (McManus et al., 2022). The evaluation process has evolved into a periodic and widely publicized system that has been refined with each cycle. Currently, the evaluation of postgraduate programs occurs every four years. The CAPES Open Data System provides unique identifiers for Brazilian institutions, ensuring the reliability of information related to the ecosystem of science, technology, and innovation (CAPES, 2025).

4. Disambiguation of research entities - persistent identifiers

Persistent identifiers are unique and globally resolvable identifiers that adhere to an openly defined schema (Collins et al., 2018). Introduced in 1997, the DOI serves as a prime example of a persistent identifier, assigned to a digital object to ensure its independence from changes in Uniform Resource Locators (URLs), as discussed by Boudry and Chartron (2017). The information regarding scientific activity is distributed across various entities, including authors, journals, institutions, and publications, among others. These entities are typically mapped to data entities in databases to create a data model that facilitates the translation of inquiries about scientific activity into queries or filters within these databases. Some data models related to research are highly complex and well-developed, aiming to ensure the traceability of research entities. An example of this is the OpenAIRE graph (Vichos et al., 2022), which is linked to the OpenAIRE database (Manghi et al., 2010).

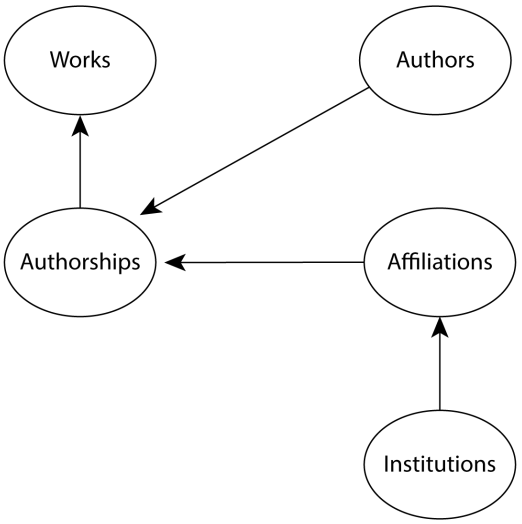
The connections that enable the development of such models require the identification of research entities, ideally employing clear and unambiguous identifiers. The most significant of these are:

- DOI and ARK for Publications (Freire et al., 2023);
- ROR for Institutions (Welke & Krause, 2024);
- ORCID for Researchers (Schnieders et al., 2022);
- ISSN for Journals (Bequet, 2022).

Other related elements may include patent identifiers, company registries from national offices, and similar resources. Research information system databases typically collect data from forms manually completed by researchers and staff, as well as from various online databases. The diversity of sources and the inherently variable nature of human-entered information present challenges for matching entities both across different databases and within the same database. Variations in titles, the formatting of names with their multiple components, abbreviations, and translated names for research institutions all highlight the importance of persistent identifiers.

The presence of persistent identifiers would allow for all research entities to be seamlessly matched, making the data model for researcher model in Figure 1 a direct data model for bibliographic databases.

Figure 1: Main research entities considered.



However, the coverage of any of such identifiers is incomplete and many biases could be identified in most databases (Baglioni et al., 2023). However, a partial presence of identifiers is usually used in gross analysis and partial matching. In the case of the present work, it is also used as clues.

5. Methodology

In order to take advantage of the qualities of local databases that are focused on entities and present a sort of Golden Set and cross their available information with globally encompassing databases, we propose related persistent identifiers as clues. In our case, the incomplete presence of DOIs for authors in the Lattes database and also in the Capes database will serve as a filter for detecting and disambiguating research entities, namely, authors and institutions.

By taking common DOIs that appear simultaneously on both databases, it is possible to narrow down the set of possible names to disambiguate. Starting from the set, a distance metric must be adapted to the names being compared.

The methodology was applied by crossing the three datasets, Lattes, Capes and OpenAlex using Google BigQuery as SQL database platform. The DOIs associated with authors from Lattes and DOIs associated with institutional evaluations from the Capes database were collected and a list of possible names for each entity was assembled.

For both cases, a large number of DOI matches means a higher possibility of names matched. That way the pairings of candidate names can be ordered by the sequence of larger numbers of common DOIs. Also, the pairings are ordered by smaller metric distance in names. So, the matching occurs for a certain threshold of distance being satisfied for the most likely candidate given the number of common DOIs. The value for threshold is manually tested by looking at the worst cases in the list of pairings previous to the matching.

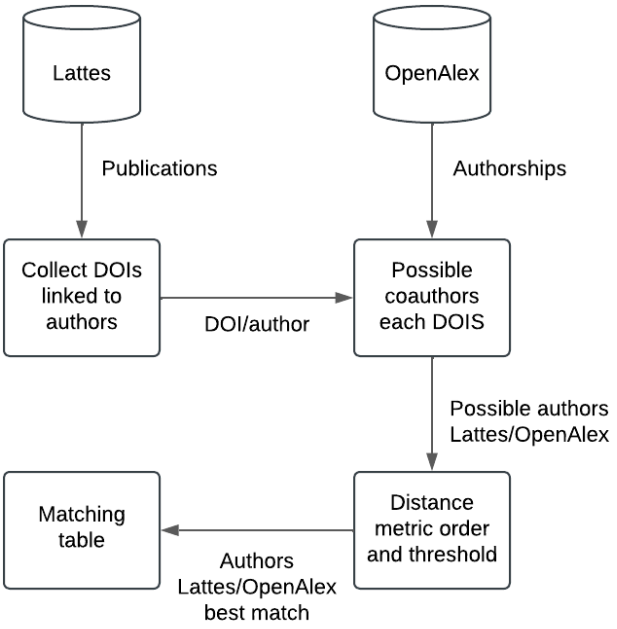
5.1. Text distance for authors

When matching titles, it is common to employ metrics that compare text as strings. These metrics are based on character variations, with the Levenshtein distance being the most

prevalent. Although this method is widely used for comparing human names, it is not entirely suitable for this application, as names are often presented in various alternative forms that may omit family or given names or replace them with initials.

An attempt to match names using this metric may create artificial distances and proximities, making the matching process less effective in many instances. To address these limitations, this study employs an adaptation of the Levenshtein metric, focusing on specific segments of the names. It considers only the names that are present, their initials, and their relative order. The names are split in parts and possible absent intermediate names are accepted as matching (render 0 distance) when the order is preserved and an initial letter is matched. The code is available for details.

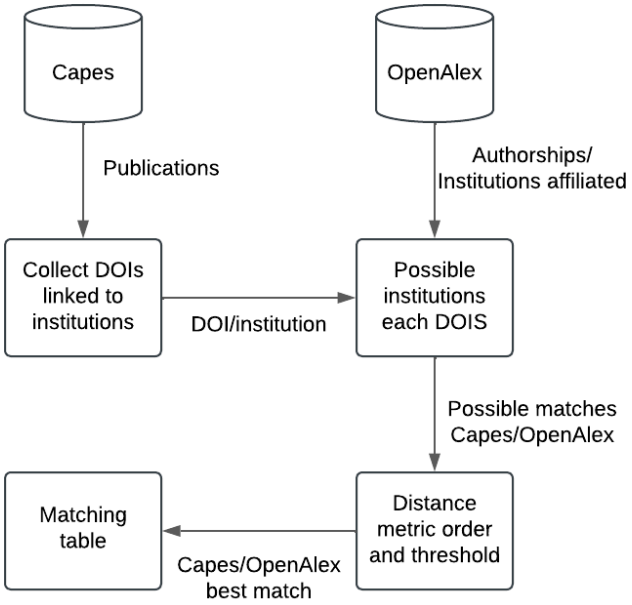
Figure 2: Author names disambiguation.



5.2. Text distance for institutions

We developed a distance measure specifically for acronyms. We collected all the name variations from OpenAlex for comparison. For safety, we have also checked all the name variations for institutions inside the ROR dataset. Tha accounts for standard translations of the names. Our initial step involved comparing both the acronyms and their corresponding names, focusing solely on those that shared common DOIs. These DOIs were identified through the manual declaration of graduate programs in the Capes Evaluation, a unique process. For the method presented, it is not necessary to provide all the DOIs; therefore, it is sufficient to have an adequate group for an institution to be cataloged in OpenAlex.

Figure 3: Institution names disambiguation.



6. Results and discussion

6.1. Authors

The number of Lattes identifiers (representing researchers) with at least one valid DOI for applying our methodology is 154,474. The method identifies 151,318 authors in the OpenAlex database. Contrary to expectations, this discrepancy is not due to authors being untraceable; rather, it arises from multiple individuals being assigned to a single author in the OpenAlex database.

The number of matches exhibiting an exact one-to-one correspondence is 148,431. This corresponds to 6,043 individuals in Lattes being identified as 2,887 authors in OpenAlex. This unusual phenomenon is primarily attributed to the disambiguation algorithm (Barrett, 2023), which compares names and employs fuzzy indicators, such as collaborations and research areas, to identify individuals. Ultimately, it relies on ORCID; however, this identifier is often missing in many cases.

Tables 1 and 2 present the errors in disambiguation in both directions. Table 1 presents the graver error of researchers who are combined in a single OpenAlex author data row. Table 2 presents the simpler error where researchers are split into several author profiles.

Figure 4: DOIs used in the matching of authors.

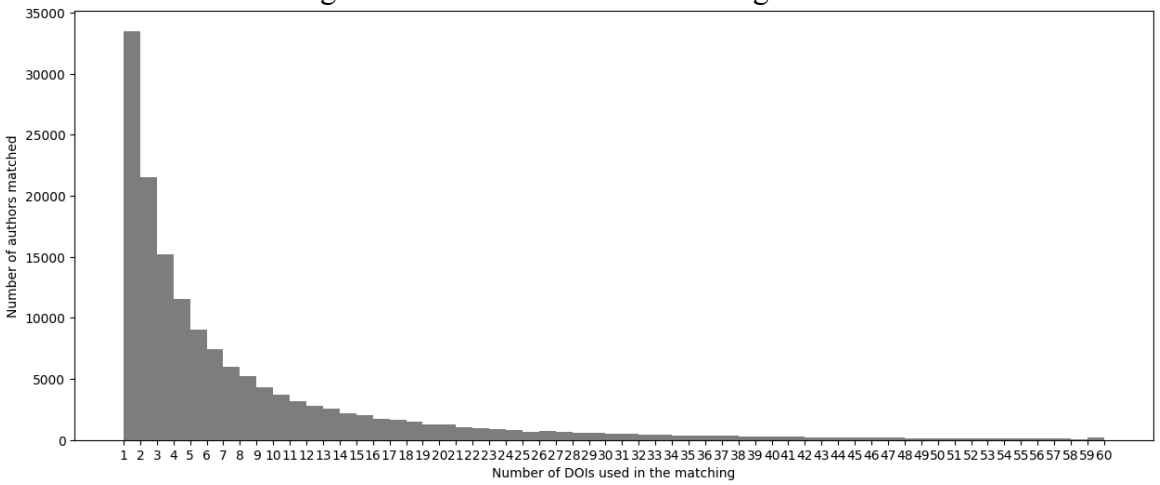


Table 1. Total of assigned identifiers to a single author identified after matches our methodology.

Total of identifiers	**Total of assigned**
1	148,431
2	2,645
3	220
4	17
5	5

Table 2. Total of researchers in Lattes splitted to different identifiers after matching our methodology.

Total of splits	**Total of researchers**
1	137,632
2	15,526
3	1,205
4	101
5	6
6	4

Figure 5 illustrates the institutional affiliations of misclassified authors, while Figure 5 presents the institutional affiliations of correctly classified authors. Figure 6 compares both correctly classified and misclassified authors, categorizing them by research field.

Figure 5: Institutional affiliations of misclassified authors.

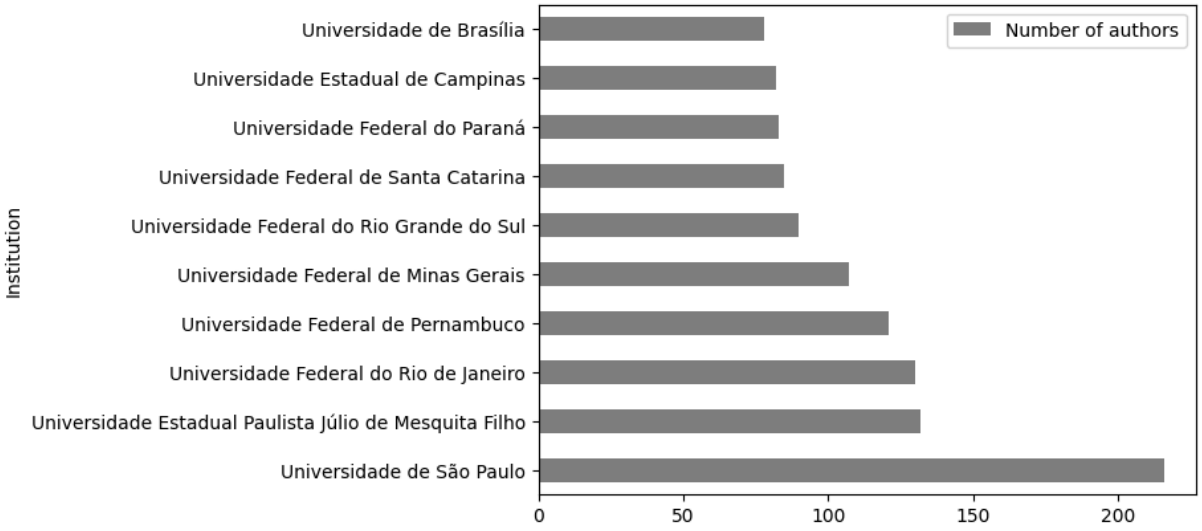


Figure 6: Institutional affiliations of correctly classified authors.

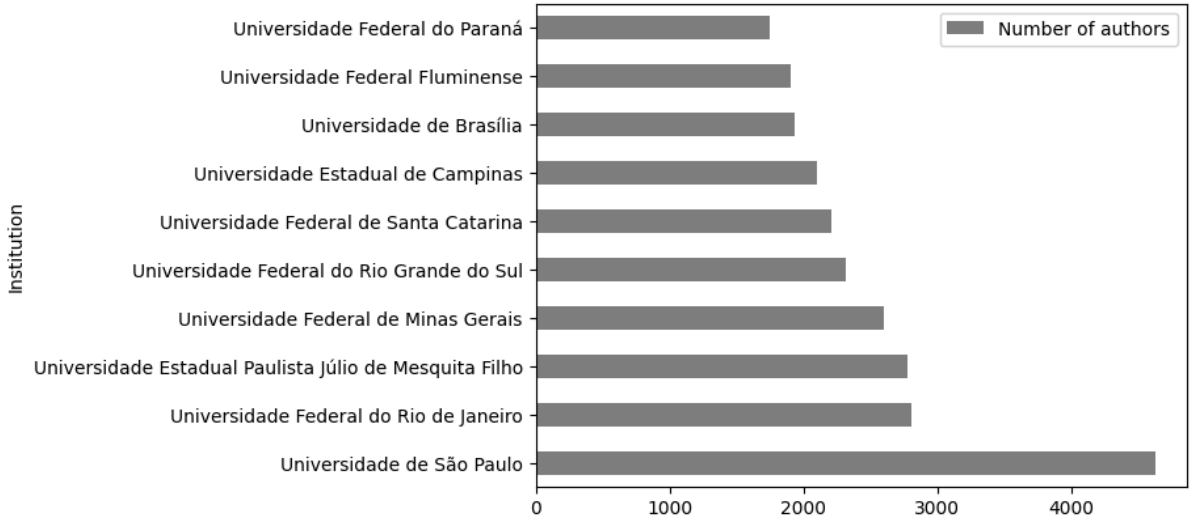
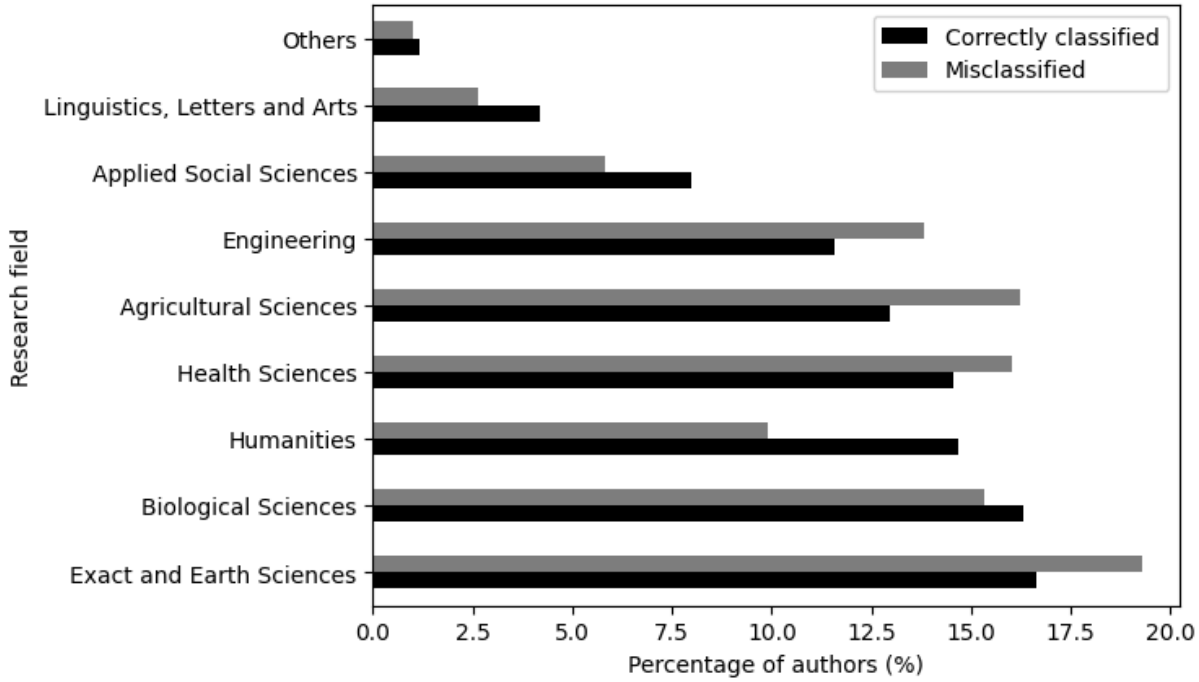


Figure 7: Comparison of authors by research field.



6.2. Institutions

As for institutions, every single entity identified as an institution in the CAPES database is matched to only one institution in OpenAlex, meaning that, for that dataset, there is no splitting error. However, the graver opposite error is present: there are a few cases of OpenAlex institutions merging several institutions from the CAPES database. Table 3 presents the number of such occurrences, it is possible to see that 250 institutions in OpenAlex are correctly matched, since they point to a single institution in CAPES. 19 OpenAlex institutions merge to real institutions as registered in CAPES and so on. In Table 3, we considered that parent and affiliated institutions are the same institutions in order to ascertain the rate of success. Different campi of a single university are considered one institution in that table. That way, the original number of institutions falls from 388 to 359.

Table 3. Total of assigned identifiers to a single institution identified after matches our methodology. The first row indicates correctly matched.

CAPES institutions	**OpenAlex institutions**
1	250
2	19
3	10
7	2
4	2
5	1
14	1

In Figures 8, 9 and 10, we try to explore the differences between the correctly and incorrectly classified institutions. We can see in Figure 8 that 333 institutions are correctly matched and 55 are not. In Figure 9 we can see that the impact of disambiguation falls on 228 postgraduate programmes associated with incorrectly assigned institutions.

Figure 8: Total of institutions identified

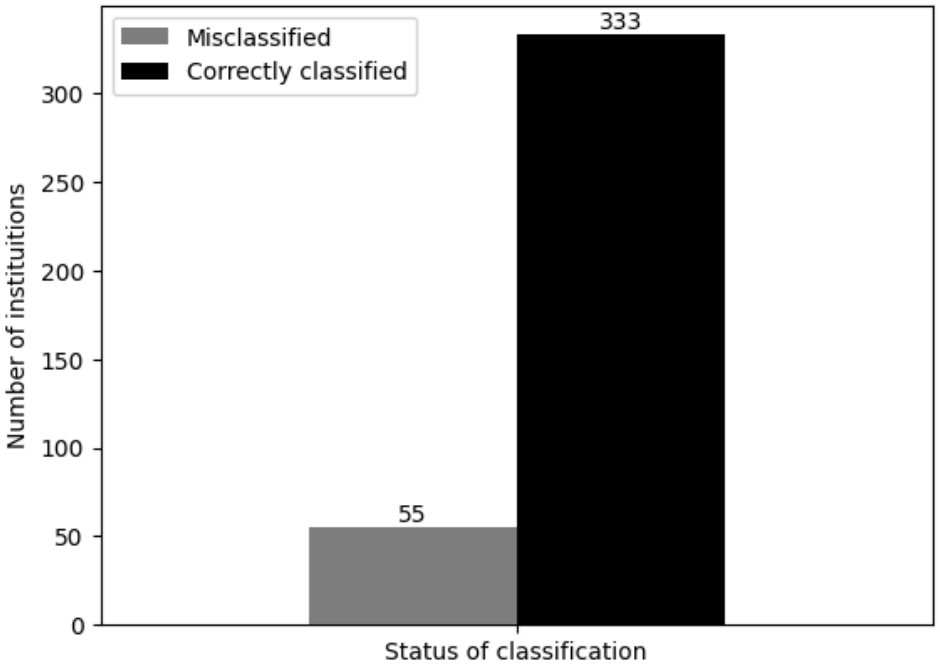


Figure 9: Total of postgraduate program in the identified institutions

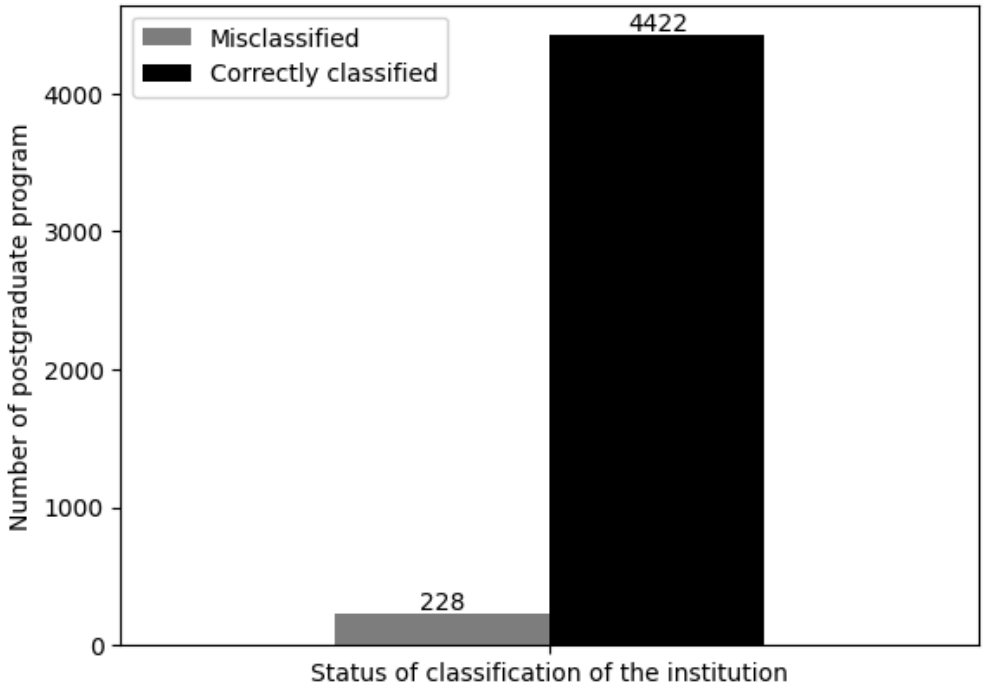


Figure 10 compares areas to show that some areas of postgraduate studies are better disambiguated than others. Table 4 presents the number of works (though DOIs) and their citations associated with incorrectly identified institutions. Table for presents number of works and citations for the institutions that were most merged with others.

Figure 10: Comparison of postgraduate programs in the identified institutions by research field.

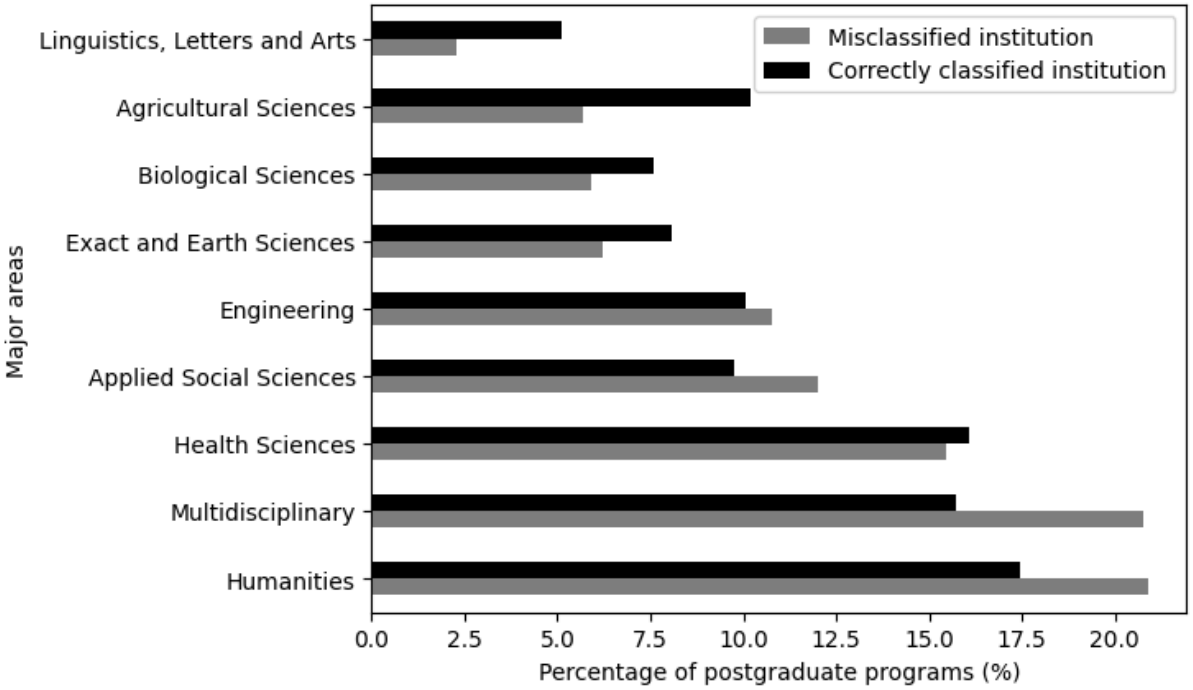


Table 4. Bibliometric measures related to DOI of misclassified institutions.

Total of DOIs	**Total of Citations**	**Average Citations**
21,054	351,541	16.70

Table 5. Bibliometric measures related to the top ten misclassified institutions with the most citations.

Name of the Institution	**Total of Citation**	**Total of DOIs**	**Average Citations**	**Total of Postgraduate Programs**
Pontifícia Universidade Católica do Rio de Janeiro	56,019	3,066	18.27	34
Universidade Estadual do Norte Fluminense Darcy Ribeiro	29,564	1,626	18.18	14

Universidade Federal de Alfenas	24,863	1,545	16.09	20
Universidade Nove de Julho	22,618	1,485	15.23	14
Fundação Antonio Prudente - Hospital A. C. Camargo	17,919	603	29.72	2
Instituto Sírio-Libanês de Ensino e Pesquisa	16,848	458	36.78	2
Sociedade Brasileira de Fisiologia	14,984	723	20.72	1
Sociedade Brasileira de Física	14,597	1,378	10.59	1
Universidade Presbiteriana Mackenzie	13,922	959	14.52	15
Museu Paraense Emílio Goeldi	13,361	459	29.11	3

6.3. Future research and discussion

We believe that such a matching and disambiguation methodology that feeds on local and institutionalised databases is the key to improve global databases. Approaches that rely solely on agnostic approaches and clues collected only from bibliographical sources and aggregators are not enough and tend to accumulate biases of presence. This means that large institutions with a lot of collaborations tend to be merged with smaller ones when agnostic methods are used. Something similar happens to authors when comparing similar names of people with too different levels of publication and collaboration.

Using local databases, the global data can be improved and even corrected for more precise analyses and their feedback will render better results in the use of global databases.

Using the matching tables from Lattes and CAPES to OpenAlex, several research questions can be posed involving mobility of researchers, epistemic diversity, gender disparities among others. These are lines of research we aim to develop.

Open science practices

All data sources are open and can be collected over the internet with the relevant links. Aggregate and cleaned datasets are made available using Google BigQuery in the context of project InSySPo at cloud.console.google.com/bigquery?project=insyspo. Codes for analysis and plots are available at the repository github.com/insyspo/match_local_global_ORI.

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Author contributions

Alysson Fernandes Mazoni - Conceptualization; Data curation; Methodology; Investigation; Validation; Writing – original draft.
Luis Fabiano Farias Borges - Conceptualization; Data curation; Methodology; Investigation; Validation; Writing – original draft.
Estevão Fernandes Macedo - Conceptualization; Data curation; Methodology; Investigation; Validation; Writing – original draft.
Esteban Fernandez Tuesta - Writing – review & editing; Supervision.

Competing interests

Author Luís Fabiano Farias Borges is affiliated with CAPES, which is the source of one of the databases.

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