

Coverage of academic citation databases compared with coverage of scientific social media

Personal publication lists as calibration parameters

Coverage of academic citation databases

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Fee Hilbert, Julia Barth, Julia Gremm, Daniel Gros, Jessica Haiter, Maria Henkel, Wilhelm Reinhardt and Wolfgang G. Stock
Department of Information Science, Heinrich Heine University, Dusseldorf, Germany

Abstract

Purpose – The purpose of this paper is to show how the coverage of publications is represented in information services. Academic citation databases (Web of Science, Scopus, Google Scholar) and scientific social media (Mendeley, CiteULike, BibSonomy) were analyzed by applying a new method: the use of personal publication lists of scientists.

Design/methodology/approach – Personal publication lists of scientists of the field of information science were analyzed. All data were taken in collaboration with the scientists in order to guarantee complete publication lists.

Findings – The demonstrated calibration parameter shows the coverage of information services in the field of information science. None of the investigated databases reached a coverage of 100 percent. However Google Scholar covers a greater amount of publications than other academic citation databases and scientific social media.

Research limitations/implications – Results were limited to the publications of scientists working at an information science department from 2003 to 2012 at German-speaking universities.

Practical implications – Scientists of the field of information science are encouraged to review their publication strategy in case of quality and quantity.

Originality/value – The paper confirms the usefulness of personal publication lists as a calibration parameter for measuring coverage of information services.

Keywords Information service, Coverage, Database, Publication list

Paper type Research paper

Introduction

Coverage serves as a criterion for quality of an information service (Hood and Wilson, 2003; Lancaster, 2003). “Coverage” is defined as the ratio of the number of entities represented by an information service (sometimes also called “database”) and the number of all available entities (Naumann *et al.*, 2004). If d counts the number of all available documents in a given subject (say, a scientific discipline) and s is the number of surrogates, representing the documents from the subject area in an information service (IS), the coverage C of IS is calculated by:

$$C(IS) = s/d.$$



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A value of “1” means that all documents in the subject area are completely represented by surrogates in an information service. While the counting of surrogates (s) is unproblematic, it is very difficult to count all documents (d) in the real world of a scientific field. The borders of scientific areas are sometimes unclear. So it is not always obvious whether a document is part of a given area.

For academic scientists there are three citation-based sources which cover a large range of science: Google Scholar, Scopus and Web of Science (WoS) (Linde and Stock, 2011). The main methods of informetrics and scientometrics are publication analyses and citation analyses (Egghe and Rousseau, 1990; Garfield, 1979; Stock and Stock, 2013). The publication and citation analysis results differ depending on the choice of the information service (Adriaanse and Rensleigh, 2011, 2013; Bakkalbasi *et al.*, 2006; Falagas *et al.*, 2008; Gray *et al.*, 2012; Kaula, 2006; Kloda, 2007; Levine-Clark and Gil, 2009; Lasda-Bergman, 2012; Yang and Meho, 2006; Michels and Schmoch, 2012; Šember *et al.*, 2010). Bar-Ilan (2008) found different results for the h-index of scientists from Google Scholar, Scopus and WoS. Meho and Yang (2007) as well as Meho and Sugimoto (2009) found for the area of information science that Scopus and WoS produce different results for “smaller citing entities” (e.g. journals, conference proceedings or institutions).

With the advent of social media, new information services and new informetric analysis methods (called “altmetrics”; see e.g. Thelwall *et al.*, 2013) emerged. Now we are able to examine the scholars’ visibility on the social web (Bar-Ilan *et al.*, 2012). We can use bookmarking and reference management services both as end users looking for literature and as informetricians analysing the social impact of scientists and institutions (Linde and Stock, 2011). There are already some studies on the coverage of the social bookmarking services Connotea, CiteULike and BibSonomy (Haustein and Siebenlist, 2011; Reher and Haustein, 2010) and of the reference management service Mendeley (Thelwall *et al.*, 2013).

This study began by looking for the basis for the calculation of all the documents (d) that were used. It distinguished between four approaches on different levels:

- (1) database-based calibration parameters;
- (2) journal-based calibration parameters;
- (3) paper-based calibration parameters; and
- (4) institution-based calibration parameters.

(1) One can use a specific information service (e.g. WoS) as a gold standard and compare it to other databases. For instance Bar-Ilan *et al.* (2012) compared Mendeley to Scopus and WoS while Gavel and Iselid (2008) compared WoS and Scopus. (2) A coverage analysis of Scopus compares the journals it indexes with the list of periodicals produced by Ulrich’s (de Moya-Anegón *et al.*, 2007). This journal-based approach finds its gold standard with Ulrich’s (Jacsó, 2012). Of course, other gold standards, e.g. references to journals derived from relevant papers (Nisonger, 2008) or journal listings in specialized bibliographies (Norris and Oppenheim, 2007), are possible. Here, a journal is considered as a whole. (3) However, it is possible to disaggregate the journal level to paper level and ask how many papers from a given source (a journal, conference proceedings, etc.) are covered by the information service. This was the approach chosen by Bar-Ilan (2012) while calculating the coverage of JASIST on Mendeley. Grzeszkiewicz and Hawbaker (1996) used tables of contents from journals to create their paper-based checklist. (4) Institution-based approaches work

with the names of scientists from certain institutions and search for them in the database to calculate its coverage. For example Etxebarria and Gomez-Uranga (2010) observed (using a sample of Spanish social science researchers) problematic coverage of prestigious Spanish researchers in WoS and Scopus.

A special research problem is the language-specific and culture-specific coverage of information services. Cronin (2003) discovered the existence of “epistemic cultures” in scholarly communication and the “epistemic significance of place” (Cronin, 2008). It is possible that a textbook written with the background of a European culture will cite another canon of major scientists than an American textbook would (Cronin, 2013).

What is our approach? To calculate the amount of documents which serves as a parameter of calibration of the coverage of information services, we use scientists’ personal publication lists. Our approach is a kind of institution-based calibration parameter. Insofar as the scientists look after their own lists of publications, such lists will be (more or less) complete. The application of publication lists is not new in informetrics, e.g. Chi (2012) worked with such lists to study the publication behavior of scientists. Covey (2009) used publication lists to calculate the amount of self-archived full texts. Our approach is similar to that of Kirkwood (2012), who applied a checklist which is based on items published by the members of the community that will use the information service. “Harvest items from their publication lists, *vitas* or resumes for the checklist,” Kirkwood (2012) recommends. Her experience with this calibration instrument was positive. “The use of a publication checklist to evaluate database coverage [...] is viable,” she resumes. This approach starts on the level of a single document in a scientist’s publication list (a journal paper, a paper in proceedings, a book, etc.). It is possible to aggregate the amount of publication lists to the levels of institutions, places (say, Düsseldorf, Germany vs Bloomington, Indiana, USA) and countries (e.g. USA vs Germany). In this way it is possible to study the coverage of databases relative to epistemic cultures and places.

Our case study is the coverage of papers in library and information science of scientists working at universities in German-speaking countries (Friedländer, 2014). Being part of the national and the international library and information science community, it is important for the German-speaking information scientists to be visible in their own country as well as in the whole scientific discipline on a global scale.

The aim of this study was to collect publications from German-speaking authors to determine the amount of coverage accessible in six databases. We compared three academic citation-based databases (WoS, Scopus and Google Scholar) with three reference management and social bookmarking services (Mendeley, CiteULike and BibSonomy).

The leading questions behind this research were: How many publications are covered in the different databases? Which information service has the best coverage? How are the institutions represented? What role does the language of publication play? What are the reasons for the results?

Methods

The research objects were all German-speaking university institutes in Germany as well as in Austria which offer studies (as major and minor in Berlin, Hildesheim, Düsseldorf and Regensburg or as minor in Graz) in information science:

- Humboldt-University Berlin, Germany;
- University of Hildesheim, Germany;

- Heinrich Heine University Düsseldorf, Germany;
- University of Regensburg, Germany; and
- Karl-Franzens-University Graz, Austria.

In the German-speaking parts of Switzerland, Belgium and Italy we could not identify universities with institutes of information science. We did not include data from universities of applied sciences. With few exceptions (e.g. Hamburg's Dirk Lewandowski), the publication output of universities of applied sciences is rather low.

Schlögl's (2013a, b) papers on the international visibility of European information science (especially in the German language) are the most similar studies. Schlögl's studies present a scientometric analysis of papers from journals indexed in the WoS subject category "Information Science & Library Science."

Our research was limited to scholarly publications. Duplicates and informal published documents were unregarded. Within the scholarly publications every document was taken and scored equally because no optimal weighting scheme could be found. So every publication and every co-author was counted as "1." If a document had two or more authors from the same institution, it was counted as "1" for every co-author, but only "1" for the institution. We preferred "whole counting" (Gaufriau *et al.*, 2008) on the author and institution levels, because it is not possible to calculate the "real" amount of scientific work for every co-author of multi-author papers.

Schlögl only used data from WoS, which does not allow for an unbiased analysis of the coverage of German and Austrian information scientists in other databases. Furthermore, in the analysis all document types were considered. They were equally evaluated because there was no optimal weighting scheme (e.g. for books) which could have been chosen.

The research was conducted in the second quarter of 2013 as a part of a larger research project on information science in German-speaking countries. Only documents which were published between 1 January 2003 and 31 December 2012 were taken into account, as well as the fact that the authors had to be employed at one of the mentioned universities on the research's key date: December 31, 2012. The ten-year timespan and the reference date were rather arbitrarily chosen. This fact could perhaps lead to biased results if our study aimed to analyse the institutions' productivity. But that is not our goal; we will analyse only the institutions' coverage in information services.

We looked for all publication lists of all scientists in the five institutes. Additionally, we searched for literature by the scientists in all the mentioned databases and further sources (e.g. repositories created by university libraries). The (partly completed) literature list was sent to each scientist to check its reliability. Due to difficulties during the communication process with the faculty members 100 percent accuracy could not be guaranteed. Because we were able to collect all publication lists of all university-based information scientists in German-speaking countries and (partly with the aid of the authors themselves) checked them for completeness, we assume that our calibration set is complete.

In the ten years between 2003 and 2012 a total of 76 information scientists in German-speaking universities produced 1,017 documents. Table I shows the number of publications from all mentioned institutes as we found them in the (amended and checked) publication lists of the members of the institutes. It has to be mentioned that the publications were aggregated – publications with more than one faculty member as author were counted as "1" – and not summarized.

We have to mention limitations of our methodological approach. It would be very interesting to have a deeper look into the publications of the institutes. How many

publications per year per faculty member do the institutes have? There are some hints in Friedländer (2014) but still no detailed results. We would have to capture the timespan during which the scientists were working at the institutions and their respective working hours (part-time, full-time). However, due to German *Datenschutz* (the law governing data protection) it would be very difficult to gather exact data. Another interesting research area is the distribution of publications by document type. Are there different coverage ratios of journal papers, conference papers in proceedings, books, etc.? Both aspects remain research questions for further investigation.

We looked for all 1,107 items in the three academic databases as well as in the three social media information services. The search terms were the author name(s) and words from the title.

Results

Based on the aggregated data the institutes and different information services are compared regarding the coverage. Table II presents the percentage of the universities' publications covered in the academic databases and social media services. Among the academic citation databases, Google Scholar displays the highest average percentage of 63 percent, while WoS (including Science Citation Index, Social Sciences Citation Index, Arts & Humanities Citation Index, Conference Proceedings Citation Index and Book Citation Index) covers the smallest amount of the investigated publication lists with 15 percent. WoS and Scopus apply a selection process; it is not the aim of both information services to cover every publication. Google Scholar does not apply such a selection process.

University	Number of Publications	Number of Scientists	Relative Frequency of English Publications
Humboldt-University Berlin	180	28	50.00%
University of Hildesheim	230	13	60.87%
Heinrich Heine University Düsseldorf	240	13	32.08%
University of Regensburg	180	15	49.44%
Karl-Franzens-University Graz	187	7	32.62%

Note: $N = 1,017$

Source: Personal publication lists of the members of the institutes

Table I.
Total number of publications of members of information science university institutes in German-speaking countries, 2003-2012

	WoS	Scopus	Google Scholar	Mendeley	CiteULike	BibSonomy	Average academic databases	Average social media
Berlin	20.56	31.11	36.67	16.67	7.78	18.33	29.45	14.26
Hildesheim	20.43	42.61	79.57	12.17	3.48	17.39	47.54	11.01
Düsseldorf	8.33	25.00	50.83	22.08	8.33	27.08	28.05	19.16
Regensburg	14.44	25.56	82.22	32.22	11.67	42.22	40.74	28.70
Graz	12.30	32.62	63.64	13.37	7.49	14.44	36.19	11.77
Average	15.21	31.38	62.59	19.30	7.75	23.89	36.39	16.98

Note: In %, 100 percent: all documents of the publication lists of the institutes' members

Table II.
Coverage of documents of information science university institutes in German-speaking countries in academic databases and in social media services

BibSonomy has the predominance among the social media services with an average of 24 percent, whereas CiteULike comes in last with 8 percent. When comparing the academic databases on the institutional level, it becomes apparent that Düsseldorf is the least represented in WoS and Scopus, while Berlin and Hildesheim are covered comparatively rather well. Why is the coverage of Düsseldorf so low for WoS? Friedländer (2014) found that Düsseldorf's information scientists try to serve two "markets": the domestic (German) as well as the international (English) market. The top German information science journal (*Information – Wissenschaft und Praxis*), which publishes many papers from Düsseldorf, is not included in WoS. On the international market the Düsseldorf information scientists do not only publish in WoS-covered journals (such as *Journal of the Association for Information Science and Technology* or *Journal of Documentation*), but also in international journals which are not indexed by WoS (e.g. *Information Services and Use* or *Webology*). Here a fundamental question of publication strategy arises: should a researcher aim for the list of WoS-covered journals? Or should s/he choose those journals which are connected to the research topic, independently from the coverage of WoS? It would be a very interesting further research project to study publication strategies and how these affect the researchers' ability to become highly visible in the national as well as in the international markets.

Google Scholar (see also: Lewandowski, 2010) covers about 80 percent of the publication lists for Hildesheim and Regensburg, leaving the other three places with percentages between 37 and 64. The most covered institution in the academic databases is Hildesheim with an average of nearly 48 percent followed by Regensburg with an average of nearly 41 percent.

The social databases rarely exceed an average of 17 percent; only for Düsseldorf (19 percent) and Regensburg (29 percent) is the coverage fairly high in contrast to the other institutions. The only two institutions to exceed a 20 percent threshold in Mendeley are Düsseldorf and Regensburg. Also Regensburg is the only institution to reach the 10 percent hurdle in CiteULike and 40 percent in BibSonomy, making Regensburg the best represented institution of the study in the social media services. In comparison BibSonomy covers slightly more publications from the institutions than Mendeley, while CiteULike does not even contain half the results of the other two social databases, making it the weakest among these.

In general academic citation-based databases offer a more complete coverage than the social media services. Google Scholar represents the most publications of the study in all databases, and BibSonomy comes in first among the social media. The top represented institution in the academic databases is Hildesheim, and Regensburg is best covered in the social databases.

If assuming that at least 50 percent is sufficient, which was chosen arbitrarily, then none of the German-speaking universities which offer information science studies are only sufficiently represented in Google Scholar.

There is a correlation between the relative frequencies of English documents and the coverage of the institutes' documents in the different information services. The correlation (Pearson, two-sided) between the share of English documents and the coverage in academic databases is +0.68 on average (WoS: +0.88; Scopus: +0.62; Google Scholar: +0.38). However, we found no correlation or (in the case of CiteULike) slightly negative correlation between the amount of English documents and the institutes' coverage on social media services (all: -0.06; Mendeley: -0.08; CiteULike: -0.38; BibSonomy: +0.05). The coverage in academic databases is very highly correlated with the institutes' publication languages: the more in English, the more covered in WoS, Scopus and – to a lesser extent – Google Scholar.

Discussion

In this study we applied a rarely deployed calibration parameter for the measurement of the coverage of information services, namely the use of scientists' personal publication lists. Our example is a complete set of all publications of information scientists working at universities in German-speaking countries. Our results are – due to the complete set of publications – reliable for this sample. The same fact shows our study's limitations: it is only reliable for this case study. Further studies with broader data sets are needed to get a more complete picture of the coverage of academic and social media information services. We could demonstrate that the introduced method worked well.

There is another limitation of our study. We counted publications, but not what kind of publications they are. It would be interesting for future studies to differentiate between journal papers, books, chapters in books, conference papers in proceedings, etc. and then to calculate the specific coverage values of the different document types.

The academic databases display differences. Google Scholar has a huge data pool, but does not always provide access to full papers in their own database. Instead it links to sites which provide commercial or free access to papers. WoS and Scopus offer a fee-based service where about 12,000 (WoS) and about 19,000 (Scopus) journals were selected for indexing. There are only bibliographical records and no full texts provided.

In contrast the social media databases are freely accessible for every user on the internet who can actively index after registration. Unlike WoS and Scopus, the coverage of the social network services can be influenced by authors themselves. In social media (but not in Google Scholar, Scopus and WoS), authors can index their publications by themselves to achieve higher coverage. If the authors maintain their profiles, they can easily achieve a coverage of 100 percent. Jens Terliesner's profile on Mendeley is a good example of such active cooperation.

To date, publications are only partly documented because the majority of the investigated authors do not insert their publication lists into the databases themselves. A reason may be excessive effort required for authors to maintain publication lists in databases while pursuing their profession.

The insufficient coverage may lead faculty members to work on the quality and quantity of their publications so that these are admitted into WoS and Scopus. In the other databases, the faculty members must be willing to index the publications on their own to achieve a higher coverage.

Moreover, they can be stimulated to publish more on the international level, because scientists have to exchange their findings to forge ahead. Therefore they have to publish in English to communicate with the international information science community. As Schlögl and Stock (2004) figured out in an empirical investigation, German information scientists and especially information practitioners prefer not to read English-language journals. This result needs to be treated with caution as it may be out of date and not valid any longer ten years after the study's publication. But there is no recent study on language skills of information scientists and practitioners.

The epistemic significance of culture and place (Cronin, 2003, 2008) seems to be the decisive element of both the scientists' and institutes' publication strategies as well as the coverage of their publications in information services. Given the low coverage of WoS and Scopus as well as of all social media services and given the significance of culture and place (leading to low coverage for some cultures and places), is it really acceptable to limit studies in informetrics, scientometrics and altmetrics to raw data from such services?

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About the authors

Fee Hilbert currently works as a Media Consultant at CROSSMEDIA GmbH, Düsseldorf. She successfully completed her degree in the Department of Information Science at the Heinrich Heine University, Düsseldorf, where her thesis focussed on "Informational Cities" in the Gulf Region. Fee Hilbert is the corresponding author and can be contacted at: fee.hilbert@hhu.de

Julia Barth is a student in the Department of Information Science at Heinrich Heine University, investigating issues related to "Informational Cities".

Julia Gremm is a student in the Department of Information Science at Heinrich Heine University, investigating issues related to "Informational Cities".

Daniel Gros is a student in the Department of Information Science at Heinrich Heine University, investigating issues related to "Informational Cities".

Jessica Haiter is a student in the Department of Information Science at Heinrich Heine University, studying information and media literacy.

Maria Henkel is a student in the Department of Information Science at Heinrich Heine University, studying information and media literacy.

Wilhelm Reinhardt is an Analyst currently working at Deltamethod GmbH, Berlin. His field of expertise is SEA and SEM.

Professor Wolfgang G. Stock is the Head of the Department of Information Science at the Heinrich Heine University. He has recently published (together with Mechthild Stock) a handbook on information science.

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