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Indexing science

The growth of academic publishing, both in the proliferation of journals and the emergence of commercial publishers often unaffiliated with universities or research institutions (Björk *et al.* 2008; Larivière *et al.* 2015), has created a pressing need for efficient search tools and reliable mechanisms to assess journal credibility. These demands have fueled the development of journal indexing and ranking systems, which now play a crucial role in shaping researchers' careers, institutional evaluations, and access to funding. While their impact has been particularly pronounced in STEM and Health disciplines, the growing emphasis on interdisciplinarity has extended their influence to the Social Sciences and Humanities as well.

1. *Main abstracting & Indexing services*

Journal indexes have a long history and an undeniable importance in the research process. They aid scholars in locating relevant literature, increasing the visibility and citation potential of indexed articles, and support the counting and analysis of citations. Among the main indexes are:

1) Web of Science: in 1955, Eugene Garfield conceived the idea that led to the creation of the Science Citation Index (SCI) by his Institute for Scientific Information (ISI) in 1964. This system, which organized knowledge through citation links, anticipated both web hyperlinking and the Google Search algorithm by three decades. ISI progressively expanded its indexing scope, and, in 1976, introduced the Journal Citation Reports (JCR), which assessed journal influence and prestige through journal-to-journal citation analysis, thereby mapping the structure of scientific communication. Among its various metrics, the Journal Impact Factor emerged as the most influential. Over time, the organization underwent several structural changes, culminating in the establishment of Clarivate's Web of Science (WoS, https://www.webofscience.com/) and a renewed version of ISI in 2018, putting great emphasis on citation metrics and on the importance of journal selection based on reliable, publisher-independent criteria.

2) Elsevier Scopus: Scopus, another widely used indexing database, was launched by Elsevier in 2004 (https://www.scopus.com/). Journals are selected for inclusion based on five main criteria, with an emphasis on transparency and oversight by an independent board of subject-matter experts. This board continuously evaluates new titles using both quantitative and qualitative indicators. Scopus ranks journals using CiteScore, SNIP (Source-Normalized Impact per Paper), and the SJR (SCImago Journal Rank) indicator. The Scopus database also underpins the SCImago Journal Rank portal, which applies the SJR metric to assess journal influence.

3) Google Scholar (GS): GS (https://scholar.google.com/) is a search engine for scholarly literature that indexes publications across disciplines and sources. It functions similarly to Google Search, using automated crawlers to find and index academic documents. Unlike curated databases, GS has no expert supervision or formal quality control and includes grey literature and non-peer-reviewed content. Search rankings are influenced by several factors: citation count, presence of search terms in the title (with no synonym matching), recency of the article, and prominence of the author or journal (Beel, Gipp 2009). Journals are ranked through Scholar Metrics, updated annually and based on indicators such as the h-index, h-core, and h-median, calculated over the past five years. Similar metrics apply to authors (e.g., h-index, h10-index), while individual papers are ranked by citation count, as in the 'Classic Papers' section. Bibliographic data and citation links are extracted by automated parsers, which may introduce errors due to the lack of manual verification. As a result, GS can suffer from inaccuracies in citation counts and article rankings.

4) ANVUR: The National Agency for the Evaluation of the University System and Research (ANVUR) is the Italian authority responsible for assessing the quality of higher education and research since 2011 (https://www.anvur.it/it). Among its quality control activities, ANVUR classifies scientific journals for the purpose of evaluating scholars' National Scientific Qualification (ASN) indicators. However, ANVUR does not rank journals; instead, it classifies them as either scientific or scholarly or assigns them Class A status. This classification applies only to the Humanities and Social Sciences, whereas other disciplines rely on bibliometric

indicators. To be included in ANVUR's list, a journal must undergo an evaluation process. Furthermore, the classification lists are reviewed at intervals of up to five years to verify that journals continue to meet the necessary requirements and reflect the evolving scientific landscape.
5) Other A&I services: The number of databases and abstracting and indexing (A&I) services has grown rapidly with the spread of the Internet, aiming not only to connect scientific data and publications, but, more importantly, to manage citation tracking among scholarly works.

a) CrossRef is a nonprofit organization providing open digital infrastructure for the scholarly research community (https://www.crossref.org/). It is the largest Digital Object Identifier (DOI) Registration Agency of the International DOI Foundation. Rather than hosting full-text scientific content, CrossRef facilitates links between distributed content on external sites through open metadata and persistent identifiers.

b) COCI (OpenCitations Index) is an open and freely accessible index of citation data derived from CrossRef (https://opencitations.net/index/coci). It provides structured bibliographic and citation metadata. COCI follows open data principles, allowing unrestricted reuse of its content. Users can access and query COCI data via SPARQL endpoints, REST APIs, and bulk downloads, making it a valuable resource for bibliometric analysis and scholarly network exploration.

c) Dimensions is a comprehensive research data infrastructure that enables users to explore connections across various scholarly outputs (https://www.dimensions.ai/). It integrates a wide range of linked data, including grants, publications and datasets. Publications are ranked based on: 1) total citations received from any publication type; 2) Field Citation Ratio; 3) recent citations, the number of citations received in the past two years; 4) Altmetric Attention Score.

d) Microsoft Academic was a free, AI-driven academic search engine developed by Microsoft Research (https://www.microsoft.com/en-us/research/project/academic/). It provided access to a vast collection of scholarly publications, authors, institutions, and research topics, leveraging natural language processing (NLP) to extract and analyze metadata. It played a key role in academic discovery until its shutdown in December 2021, after which its data contributed to the development of OpenAlex and other research indexing projects.

e) OpenAlex is a free and open catalog of global scholarly research aimed at indexing academic outputs (https://openalex.org/). It allows users to search using various metadata fields. Works are ranked solely by citations. Its primary data source is Microsoft Academic. Data can be accessed via a free API.

f) Semantic Scholar is an AI-powered research discovery platform that enhances academic search through natural language processing (NLP) and machine learning (https://www.semanticscholar.org/). It extracts key insights, summarizes findings, and identifies influential papers across millions of publications. Semantic Scholar prioritizes context and impact analysis rather than simple keyword matching. The platform covers a wide range of disciplines, with a strong emphasis on computer science, biomedical research, and AI-related fields.

2. *Academic social networks*

1) ResearchGate is a social networking platform designed for researchers and scientists to share their work, collaborate, and engage with the global academic community (https://www.researchgate.net/). It allows users to upload publications, ask and answer research-related questions, and track citation metrics. It serves as a repository where researchers can disseminate their work and connect with peers, complementing traditional academic databases and indexing platforms. ResearchGate generates its own citation index based on full-text documents found by its web crawler and those uploaded by users. Citations, along with other indicators, are used to calculate the Research Interest Score. In addition to RIS, ResearchGate uses two versions of the h-index to rank authors, one that includes self-citations and another that excludes them. The h-index is calculated solely based on the publications listed in users' profiles.

2) Academia.edu is an online platform that enables researchers to share their publications, follow topics of interest, and engage with the academic community (https://www.academia.edu/). It serves as a repository where scholars can upload their work, discover relevant research, and track readership metrics. While Academia.edu enhances visibility and networking opportunities, it is not a formal indexing service. Unlike traditional academic databases, it operates on a freemium model, offering additional analytics and promotional features to paying users. It provides engagement metrics such as profile views, document downloads, and mentions, but it does not have a proper scoring system.

3. *Index comparison*

An analysis of the main indexing systems reveals that differences in inclusion policies, citation management, and ranking criteria can lead to significantly divergent outcomes. The most substantial variation concerns inclusion criteria, which range from rigorous quality-based selection to broader indexing of web-crawled content. To assess these discrepancies, the following comparison was conducted: 1) the number of journals categorized under 'Archaeology' was retrieved from Scopus, Web of Science, Dimensions, OpenAlex, and Google Scholar; 2) the top 20 journals in each index were compared, resulting in a combined list of 63 unique journals; 3) a ranking score was calculated for each journal based on its relative position across the indexes, weighted by the number of indexes in which it appeared:

Notably, only 11 of the 63 journals appear in at least three indexes, and just one journal is included in all five. This classification issue also affects the alignment between these databases and the ANVUR Classe A list. Among the 63 journals identified: 25 (approximately 40%) do not appear in ANVUR's Classe A, including several clearly archaeological titles; overlaps with ANVUR vary: OpenAlex and Dimensions share 15 of the top 20 journals, Google Scholar 14, WoS 13, and Scopus 12. Interestingly, the most selective indexes (WoS and Scopus) exhibit the lowest overlap with ANVUR, despite ANVUR itself being grounded in quality-based selection.

This suggests that different notions of 'quality' and disciplinary relevance coexist across indexing systems, and that relying on a single index or metric may produce a distorted representation of a research field. A more nuanced, pluralistic approach to the evaluation of journals and of scientific production in general is therefore needed, particularly in multidisciplinary or evolving disciplines such as archaeology.

4. *Indexes and (what matter in) archaeology*

In an ever-expanding body of scientific literature, indexes serve three main functions: 1) they assist researchers in navigating their field; 2) they act as a quality filter; 3) they provide metrics to evaluate the performance of scholars, journals, and institutions. The first function, facilitating literature search, is straightforward, though it's important to remember that results depend on where one searches. The selection operated by so-called 'trusted indexes' (such as Scopus and Web of Science, which are commonly used in institutional evaluations) can be seen, only to some extent, as a form of quality control. The third function, measuring academic performance, is more complex. As noted earlier, metrics significantly influence academic careers in many disciplines. These metrics rely heavily on citation counts, which raise fundamental questions about what constitutes a meaningful citation and what should be considered relevant for the advancement of a discipline. A full exploration of this issue would be extensive; instead, we will reflect on some aspects specific to the field of archaeology: 1) elevating monographs: indexing systems must incorporate monographs, particularly those published in series with rigorous quality protocols comparable to peer-reviewed journals; 2) recognizing regional specialization: indexes must account for journals focused on specific regions and chronological periods; 3) embracing digital transformation: as a discipline, we should champion the creation of digital repositories indexed with the same rigor as traditional monographs; 4) valuing depth over volume: to effectively utilize metrics based on these reimagined indexes, we must consider the scope and magnitude of individual contributions rather than simply counting outputs.

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