PROBLEMATIC ISSUES OF H-INDEX CAPTURING –
HOW TO WRITE PAPERS AND MAKE LIFE EASIER FOR THE ALGORITHMS

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Abstract:

Differentiation/ranking of authors in the scientific sphere is carried out according to their influence on the particular field(s) of science. The impact of the contribution is measured by the impact a text has on the development of the field/issue. It can be measured by the usage of ideas from other researchers works given as citations. Nowadays, citations are tracked by specific algorithms and citation management systems that have access to various databases, catalogues and bibliography systems through metadata.

In the presented article, I discuss problematic issues that authors are facing while writing texts in different languages (other than the English language) and publishing them in periodicals. The most popular (often indicative) texts/authors still fail to be captured/cached by the algorithms, therefore creating an imbalance between the actual number of citations performed by other scholars and cached h-index displayed by the algorithm. The paper discusses the causes of the problem and suggests solutions for both authors and publishers.

Keywords: citation, index, impact, article

Introduction

Authors' success in the science sphere partly depends on the significance of their studies for a particular field of science or public in general. It is rather measurable whether the study is important or not, based on the principle that "they discuss the important". When talking about scientific studies and texts, their significance is defined by the citations made by other authors/scientists in their works. Citations can be encountered in the form of a periphrases, quote, remark, comparison, references and many other. It is important that the text shows connection between the discussion and the author allowing a reader to connect a certain idea to its author. It is widely believed that the higher the quotation index of an author/text, the more important the text in the related field. The more influential (with higher quotation index) works a scientist has, the more valuable his/her new/following texts become in the scientific society. To put it simply, the success of a scientific carrier (in the science sphere) partly depends on the level of a text citation/usability. To analyze the text usability, systemic recording of certain specific metadata (e.g. author, title, publication, year etc.) must be enabled, which is associated with many programming algorithms and systems deployed in the modern world. Failure to collect the metadata or using it improperly (non-systemic, far from style use) is one of the reasons why algorithms

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struggle to process and record the data. Although authors are trying to make references to the sources they use, non-systemic citations deprive the authors of the possibility for their (referred) works to be identified through the citation recording systems or software.

Below, I discuss the root causes of the problem and the means of solving it.

Impact-factor and periodicals

Impact-factor[2] (IF[3] or JIF[4]) is a scientific-metrical index, one of the subfields of bibliometry. There are different models of measuring an impact-factor in the modern world. Mainly, the impact-factor shows the average citation index of a paper for the last two years. Publications with a higher impact-factor are considered more influential, compared to those with lower impact-factor. The word (impact-factor) itself shows that it measures the influence of the journal/text in some particular field of science.
Standard calculation of impact factor used to be carried out through the following formula:

$$Impact-factor = \frac{Citation_{Year-1} + Citation_{Year-2}}{Publication_{Year-1} + Publication_{Year-2}}$$

Scientific Journal Rankings (SJR)[5]

Advanced information technologies and improved search engines/systems enabled the extensive bases of scientific journals to carry out continuous and accurate statistical analysis of magazines and authors' citations. One of them is SCImago[6], founded in 2007, which calculates and publishes the ratings of scientific journals based on Elsevier[7] publications' base and search platform Scopus[8][9] (SJR[10], SCImago Journal Rank[11]).

H-Index

H-Index[12] or Hirsh Index is a metric of scientists' productivity and impact measured through publications and their citations. The metric is calculated according to the number of a scientist's cited works. Synonyms for h-index are Hirsch index and Hirsch Number.

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[2] Designed by Eugene Garfield, founder of the Institute of Scientific Information (ISI). Since 1975, impact has been measured annually for journals in JCR (Journal Citation Reports) list. The system of reports was acquired by Thomson (Thomson Scientific & Healthcare) in 1992 and became known as Thomson index. In 2018, Onex Corporation purchased it and founded a new corporation called Clarivate (Analytics), current publisher of JCR (Journal Citation Report).

[3] Impact Factor

[4] Journal Impact factor

[5] Also known as SCImago Journal Rank (SJR)

[6] Scimago Lab. (2020). SJR : Scientific Journal Rankings. https://www.scimagojr.com/journalrank.php

[7] Elsevier. (2020). An Information Analytics Business. https://www.elsevier.com/

[8] Elsevier. (2020). Scopus Preview. https://www.scopus.com/home.uri

[9] Elsevier. (2020). What is Scopus Preview? - Scopus: Access and use Support Center.
https://service.elsevier.com/app/answers/detail/a_id/15534/supporthub/scopus/#tips

[10] Scimago Lab. (2020). SJR : Scientific Journal Rankings. https://www.scimagojr.com/journalrank.php

[11] Ibid.

[12] The index was suggested in 2005 by Jorje Hirsch, a physicist at UC San Diego, to determine the scientific impact of theoretical physicists. Also see: Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. Proceedings of the National Academy of Sciences of the United States of America, 102(46), 16569–16572. https://doi.org/10.1073/pnas.0507655102

Hirsch index was introduced to measure the productivity of scientific studies as it provides a more accurate assessment than the total number of publications and citations.[13] H-index can be used to compare the productivity of the scientists working in the same field and the impact of their texts. Since the number of citations varies in accordance to the discipline, it would be inaccurate to compare h-index of the scientist, who publishes studies in the field of biology and the one who works in the field of law. There are different citation traditions according to the discipline (nowadays, biology and medicine are considered to be the leading fields). H-index is calculated based on the distribution of a researcher's works citations.[14]
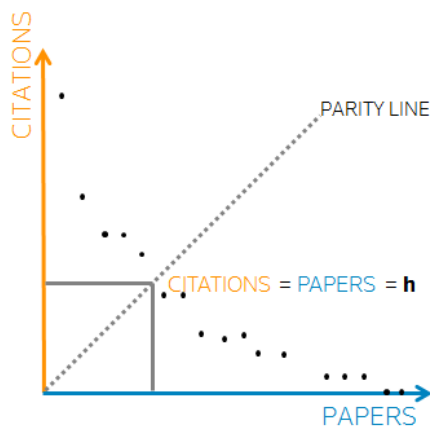
A scientist has an h-index if h number of his/her Np[15] papers are cited at least h times and the rest of his/her Np-h articles are cited no more than h times (e.g. if a scientist has 100 published papers and each of them is cited once, the scientist's h-index will be 1. If s/he has one published article cited 100 times, h-index is going to be one again. In case if one paper is cited nine times, two works – eight times, three papers – seven times and nine of them – once, h-index is going to be five). Distribution of the amount of publications corresponds to the hyperbole · N(q) ~ const *q-1 where q is the number of citations.

Calculating the h-index directly depends on the completeness of the database (number of documents in a particular field of science and technology) measuring an author's index. Measuring the h-index is directly contingent on the profile of some particular databases (there are specialized databases such as biology and medicine, while general databases such as Scopus, measure the individual authors' index). Calculating H-index depends on the methods of filling the database with documents. Apart from H-index, Google Scholar also calculates i10-index, which is equal to the number of publications with minimum 10 citations.

Platforms for scientific texts

Availability of texts in the science sphere is different nowadays than it was 10-20, 50 or 100 years ago. It is certainly possible to maintain the objectives that the authors and publishing houses had half a century or 20 years ago, but the ways of meeting and attaining them are now different.

The past, as well as current approaches of influential publishers cannot keep pace with present challenges and the progress of scientific thought. For example, after sending a text (manuscript) to a publisher, it often takes several years to reach the decision on publishing it. In the environment of rapid developments, it is impossible to wait for several years only to know the decision, particularly considering that the scientific/academic ethics do not allow authors to send the same texts to several journals at the same time. On the one hand, scientific thought/results of a study, hypothesis and theories should be delivered in a speedy manner to a reader in the modern world, and on the other hand, academic standards of providing a scientific work must be maintained. These circumstances conditioned

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[13] Ivane Javakhishvili Tbilisi State University. Department of scientific research and development (2020) Indicators for the research assessment. https://www.tsu.ge/data/image_db_innova/5-leqcia.pdf

[14] Image of the source file of calculating h-index is available here:

https://s3.amazonaws.com/libapps/customers/5095/images/h-index_visual.png

[15] (*Np*)-Total number of works: it determines a scientist's productivity, but doesn't show the relevance and influence of the publication. *Nc* determines general impact of the work, however, according to this criterion, a scientist, whose productivity is limited with one or two influential articles as a co-author, might receive rather a high index. *Nc/Np* – number of citations per publication.

the emergence of different internet platforms. Formation of the platforms was preceded by the demand for the environment which would bring science enthusiasts together, both authors and readers. There was also a demand for a prompt feedback, particularly on social interaction/network among researchers/authors, readers and institutions.

Platforms provide a space for both published and unpublished texts. We can say that publishing an article on one of the platforms serves the same purpose as publishing it in a journal – to deliver the author's ideas to the reader, and this can be done as soon as the text is finished and published on the platform without waiting for the publisher's decision for months.

I would distinguish several platforms that hold leading positions in the world at the moment of writing this text (according to the number of users and articles).

Microsoft Academic[16] - a platform with more than 240 million registered authors[17] and roughly the same number of publications, carrying out the indexation of articles. The registered users have access to a vast amount of scientific texts as well as information about science conferences. Te members can receive updates and keep track of citations of the papers in their area of interest.

Google Scholar[18] - considered to be one of the most democratic platforms. It is, on the one hand, a powerful search engine able to find information through metadata in many different scientific bases. It can also measure the authors' h-index and i10-index of all time or for a five-year period.

Researchgate – one of the most influential scientific social platforms. Researchgate is an European commercial project (social network) offering the scientists a room for efficient communication, opinion and text sharing. Registered members can ask questions, start and join discussions, publish their projects and share the news with people interested in the projects, subscribe to newsletters about vacancies and conferences. This is one of the universal platforms on the internet today providing the scientists with a space for text-sharing and interaction. The platform also calculates the score of authors' impact - RG Score[19] based on the algorithm. Additionally, it provides an author's h-index with and without self-citations.

Mendeley[20] - an important tool for a modern researcher. Apart from being a text-sharing and networking platform, it is a powerful citation management engine which allows the scietists to use it both online and offline while working on their articles. It also allows to create many different bibliographical sets which are easy to convert into the various citation styles or systems.

Academia[21] - founded in 2008, Academia has more than 36 million registered members. It is rather a helpful text-sharing and searching resource for authors. Academia is an American commercial project, and many of its functions are not available for free, making it difficult to keep track of citations. However, the availability of the news and information about vacancies and conferences plays an important role in terms of social activity within a scientific community.

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[16] Microsoft Academic. (2020). https://academic.microsoft.com/home

[17] Microsoft Academic. (2020). ETAP - Authors. https://academic.microsoft.com/authors

[18] Google Scholar. (2020). https://scholar.google.com/schhp?hl=en

[19] ResearchGate Score

[20] Mendeley - Reference Management Software & Researcher Network. (2020). https://www.mendeley.com/?interaction_required=true

[21] Academia.edu - Share research. (2020). https://www.academia.edu/

Publons – a commercial platform acquired by Clarivate in 2017 (Web of Science, EndNote and Thomson Reuters also co-own the platform, hence, registration on one of these resources enables users to access all the four systems). Publons offers a free service and allows to follow scientific publications, award ceremonies and blogs. It also provides the users with Web of Science ID, with which you can track authors in other search systems.

Scopus[22] - the Elsevier's[23] abstracts and citation database functioning since 2004. It consolidates more than 36 thousand journals (more than 34 thousand of which are peer-reviewed) published by approximately 12 thousand publishers. It is believed that all the journals in this base are of high quality and meet international standards in the academic sphere. Scopus search system also allows to find the records in patent databases and to measure h-index, citation index, SJR and SNIP.[24]

ORCID[25] - founded in 2012, ORCID provides a digital identifier which allows to identify an author. The need for a digital identifier emerged from the reality that due to a large number of people, a name cannot be a unique identifier anymore as many people have the same name. Also, the change of the last name often caused the loss of the author's track. ORCID is an open register/database, where everyone can receive their own, individual and unique digital identifier as authors in the academic sphere. Members can create personal or official account on ORCID, also add other personal identifiers such as their biography and other names they have used for publishing their texts under pseudonyms. Here you can find the news and information about recent/future events in the academic sphere. The platform is equally important for both individual authors and publishers/educational communities, as it allows the authors' identifiers to be integrated into scientific studies.

Citation formats

The purpose of citations is to create a chain/connection between the reader and the text/its author – to enable the reader to find the author of the idea and a source where this particular idea can be found. Citation is one of the critical components, and if properly used, it allows us to protect our works from plagiarism. Plagiarism is the practice of using another person's work, ideas or inventions and pretending that it is your own. Such practice violates the copyright, as well as patent laws, and violators can be held responsible for breaking them.

While making references, we should differentiate between the categories such as citation and source. The source is a document or data in some other form, which we borrow necessary information from, and a reference is a ring in a chain connecting the source to our work.

Sources can be both published and unpublished. Sometimes, while indicating the unpublished source, it is impossible to use details such as a publisher and a page or paragraph number (locator). With an unknown written source (a newspaper cut without any citation of date or name), sometimes it is impossible to establish even such details such as the author, title and date. Since the unpublished sources are not available for everyone, it is essential to indicate the name of the source provider, place and date, when the information was given, and to provide the content of the information as well, also, to whom

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[22] Elsevier. (2020). Scopus Preview. https://www.scopus.com/home.uri

[23] Elsevier. (2020). An Information Analytics Business. https://www.elsevier.com/

[24] Source normalized impact per paper See also: Moed, H. F. (2010). Measuring contextual citation impact of scientific journals. Journal of Informetrics, 4(3), 265–277. https://doi.org/10.1016/j.joi.2010.01.002

[25] Open Researcher and Contributor ID - ORCID. (2020). https://orcid.org/

this information was delivered and where it is saved. Moreover, the credibility of the information provider can be assured.[26]

Citations can be made in the text in the form of comments at the bottom of the page (footnote), or at the end of a document, or a paragraph, as remarks or additional explanations (endnote). Bibliography or the alphabetical list of the sources used is also one of the ways of making references. Unlike citations, a bibliography does not contain any locators (number of a page) and the ring of a chain directly connecting the source to the document.

One of the requisites of referring to the source is a locator. The locator or the number of a page or paragraph of the source used allows us to find an exact location of the source acting as a coordinate in large documents. While linking a website from a vast space such as the internet, accurately indicated locator is the only way connecting the document to the online source (Abbreviation **URL** means the address of the website and is a short form for Uniform Resource **Locator**).

Sources we use for our texts can be primary (from the author's work), secondary (cited within the source we use) and auxiliary (from other sources). Importantly, sources used vary greatly in their form. It can be a newspaper, journal, annual/yearbook, essay, report, image, diagram, lecture, video, audio etc. The forms imply the existence of different types of metadata. Metadata itself is data about data. You can use metadata for a direct search, without coming into contact with the initial data. It is the data many search engines use during initial processing.

Years ago, many universities and publishing houses used to create their own citation styles, and authors were required to follow them. Before the internet, there was a completely different reality in terms of the information exchange and speed. The absence of an unified, combined style resulted in the emergence of different formats. Nowadays, there are several thousand formats used by various publishers and educational institutions throughout the world.

Variety of styles and sources in different languages, as well as the language in which a citation is made, are directly linked to how it is going to be understood by the algorithms and search engines carrying out the citation checks and measuring the citations indices.

It is worth mentioning that often the publishers themselves pick the citation style closer to the discipline of a particular study. For example, in the fields of natural sciences, sociology and psychology, they often use APA format[27][28], while in linguistics and literature MLA style[29] is more popular. For example, in the US, there is a standard of using Bluebook[30] format for a variety of legal texts. They often use Chicago style as well.[31]

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[26] Janjgava, Konstantine. (2009). Peculiarities of Citing Sources. Caucasus School of Law

[27] **A**merican **P**sychological **A**ssociation offers an author-date system of documentation, popular in disciplines of Natural sciences, sociology, psychology and physics. The system places the last name of the author and publication date in brackets after discussing the source. With direct citation, the number of the page (locator) is necessary. It allows readers to identify the source, while a detailed description of it they can see in the alphabetical list at the end of the paper, which is one of the requirements of APA style. "Author-date" system is lucid and laconic at the same time, and it is an effective way of saving the readers time and efforts.

[28] APA Style. (2020). https://apastyle.apa.org/

[29] The style suggested by the **M**odern **L**anguage **A**ssociation of America is broadly used in the Humanities, especially in linguistics and literature. Similarly to APA style, MLA style also uses citations in brackets inside the text, but unlike APA style, instead of "author-date" system it uses "author-page" one.

[30] The Bluebook. (2020). https://www.legalbluebook.com/

[31] Chicago-Style Citation Quick Guide. (2020). https://www.chicagomanualofstyle.org/tools_citationguide.html

Many journals and institutions used to create their formats of citation and still do so. These formats are based on the already existed styles, e.g. Chicago style (importantly, each style has several editions of manuals. For example, this text uses 17th edition of Chicago manual), which is then elaborated/modified; This greatly increases the number of styles and complicates efficient operation of citation management apps and engines.

Citation management platforms and software

Rapid dissemination of information today is associated with the advancement of the internet. Storing the data online and making it available for internet users allows to find it in no time. Some authors often make references manually rather than using auxiliary applications exclusively designed for citation management.

Popular text editors (e.g. Microsoft Office (Word), LibreOffice and others) have an integrated citation function into their interface allowing the users to manage sources and to indicate them according to the formula required for some particular citation style.

Despite the integration, these functions of text editors are often inconvenient for the authors working on scientific texts as the programs mentioned above are located on computers' hard drives, so the availability and use of the information they contain are somewhat limited. To improve the situation, cloud versions of text editors have been created, allowing access from any location without being connected to any particular device.

There was a demand for particular products with a prime function of managing citations, which would save the authors' time and provide them with efficient and accurate citation tools for the broad range of sources they would want to use. Many products and apps were introduced since then, offering citation management services. The management systems can be categorized into ones on some particular device and those kept on the cloud. There are also symbiotic systems, which are possible to use on one or several devices, but they are located on the cloud at the same time. The synchronization between the cloud and devices provides access to libraries and resources from any location.

Citation management systems play a significant role in scientific studies – to facilitate scientists work and, at the same time, to ensure the correct arrangement of metadata (according to the format), as well as to enable quick transformation between different styles and bibliography.

I especially would like to highlight Mendeley reference management system. As mentioned above, Mendeley is a multi-function platform for sharing research papers and generating bibliographies. It has unique features of accumulating databases, enabling the scientists to save time spent on referencing the sources. It has cloud-based apps as well as software for devices. It also has browser-integrated extensions allowing the quick reading of online documents and their metadata. Mendeley citation add-ins that are integrated into the text editing programs such as MS Office, allow the researchers to refer to the needed source in seconds while working.

RefWorks[32] is another important online service by Ex Libris. It is the engine for online bibliography and database management, allowing to import references from text documents and online sources. You can install a personal research assistant Zotero[33] as a software on your device. With Zotero, you can work with sources, and it also has an add-on to integrate into text editor programs. End-Note is a commercial reference management software acquired by Clarivate Analytics. It has both the cloud and web versions

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[32] ProQuest - About. (2020). https://about.proquest.com/about/

[33] Zotero | Your personal research assistant. (n.d.). Retrieved June 14, 2020, from https://www.zotero.org/

that can be synchronized. Citethisforme[34] is an engine on the cloud, allowing to keep the sources used. It can also easily change the formats of references and is freely available for only one bibliography. With Citethisforme paid services, it is possible to work on several bibliographies/projects simultaneously. Citationsy[35] is another version of Citethisforme – a free alternative to CiteThisForMe, which recognizes more than 9000 citation formats. It also has browser extensions allowing the rapid communication with online sources and reading of metadata.

The systems listed above have their advantages and disadvantages, and I am going to discuss them in details in my other texts.

Metadata

Metadata is the data on data. Here, the metadata represents core information allowing to establish a connection with sources one would like to find. With some papers published in periodicals (a journal, for example), information in each text (the title of the work, abstract/resume, keywords, author, publishing date, address, publisher, references, etc.) must be appropriately collected and inputted in various systems/databases storing the metadata. However, when it comes to different languages, the systems storing the metadata might not operate and accept data in some other languages. Some publishers or publications might not even be indexed in the specific catalogues storing the metadata, as they may not meet with the indexing requirement needed for these catalogues/systems. If they fail to meet any of the requirements, a catalogue/system might deny the metadata indexing of periodicals to publishers, which means it will not accept and input the metadata in its base.

In many countries, most periodicals have a minimum or no indexing of metadata at all, as they do not meet the requirements at this stage; this means a minimum level of indexing metadata for each text. Indexing metadata is essential as exactly the reading/caching/screening of metadata determines the h-index of the author. The algorithm measuring an h-index must recognize the author, associate him/her to the text and find out whether the text is referenced in other authors' works, and if it is, measure the h-index.

As an example, in 2020 only, I found more than 500 citations of my Georgian texts in various Georgian sources, however, only nine of them were recognized by the algorithm calculating an h-index. This indicates that after processing the Georgian scientific literature by the algorithm, the h-index is fundamentally different from the real impact that some scientific texts might have on their disciplines.

Conclusion – solutions to the problem

First of all, periodicals and publishers should be well aware of the process (and each phase of it) the text is going through from publishing to algorithms processing metadata. While designing a citation style for their publications, the publishers should consider the experience accumulated by reference systems. Often, it is unnecessary to create new hybrid formats, or publishers will have to think of the system/plan for thousands of algorithms to recognize their unique style. Moreover, these artificially created styles make it almost impossible for authors to use the leading reference management systems/integrators as they require to be changed manually, according to a particular publisher's requirements, which increases the probability of human errors.

While working on their texts, the authors should be using the reference management systems arranging metadata according to the style formula and compatibility, as well as rapid transformation/conversion.

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[34] Cite This For Me: Harvard, APA, MLA Reference Generator. (2020). https://www.citethisforme.com/

[35] Create citations, reference lists, and bibliographies · Citationsy. (2020). https://citationsy.com/

On the one hand, publishers should be checking the completeness and order of reference metadata in the delivered texts following the required format/style, and on the other, indexing the metadata in search systems and catalogues/databases. Each publisher should try to get their publications indexed in as many reliable and highly reputable academic reference systems as possible. For this, they must periodically take measures to align to the standards required by influential indexing systems.

Every educational institution should establish, test and adhere to academic writing standards. Moreover, these standards should, to some extent, correspond to those already established in the world. Ideally, these standards would be in line with widely accepted reference styles. Educational institutions themselves must post digital versions of their products (abstracts, studies, essays, conference proceedings, etc.) in their and/or publicly accessible catalogues by collecting and adding metadata.

The lack of collection of metadata on the products created in educational institutions, and the failure to place them in appropriate directories, leads to the fact that the researchers use the works of thousands of colleagues without affecting their h-indices since they conduct their research in a language that algorithms cannot recognize. The h-index algorithms are unlikely to handle documents that are not indexed, or there is no relevant metadata collected and inputted into the metadata collection systems.

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