

# Worth(less) papers” - are journal impact factor and number of citations suitable indicators to evaluate quality of scientists?

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## “Worth(less) papers” – are journal impact factor and number of citations suitable indicators to evaluate quality of scientists?

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*Technology driven changings with consecutive increase in the on-line availability and accessibility of journals and papers rapidly changes patterns of academic communication and publishing. The dissemination of important research findings through the academic and scientific community begins with publication in peer-reviewed journals. Aim of this article is to identify, critically evaluate and integrate the findings of relevant, high-quality individual studies addressing the trends of enhancement of visibility and accessibility of academic publishing in digital era. The number of citations a paper receives is often used as a measure of its impact and by extension, of its quality. Many aberrations of the citation practices have been reported in the attempt to increase impact of someone's paper through manipulation with self-citation, inter-citation and citation cartels. Authors revenues to legally extend visibility, awareness and accessibility of their research outputs with uprising in citation and amplifying measurable personal scientist impact has strongly been enhanced by on line communication tools like networking (LinkedIn, Research Gate, Academia.edu, Google Scholar), sharing (Facebook, Blogs, Twitter, Google Plus) media sharing (Slide Share), data sharing (Dryad Digital Repository, Mendeley database, PubMed, PubChem), code sharing, impact tracking. Publishing in Open Access journals. Many studies and review articles in last decade have examined whether open access articles receive more citations than equivalent subscription toll access) articles and most of them lead to conclusion that there might be high probability that open access*

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*articles have the open access citation advantage over generally equivalent pay-for-access articles in many, if not most disciplines. But it is still questionable are those never cited papers indeed "Worth(less) papers" and should journal impact factor and number of citations be considered as only suitable indicators to evaluate quality of scientists? "Publish or perish" phrase usually used to describe the pressure in academia to rapidly and continually publish academic work to sustain or further one's career can now in 21. Century be reformulate into "Publish, be cited and maybe will not Perish".*

Key words: *citation, self-citation, citation cartels, open access, accessibility, visibility, new technologies.*

## *Introduction*

Technology driven changings with consecutive increase in the on-line availability and accessibility of journals and papers including their historical archives rapidly changes patterns of scholarly/academic communication and publishing. The traditional approach of research dissemination reaching its conclusion once it has been published has been changed in last decade with an explosive growth in additional forms of media for the dissemination of publications and associated research data, analyses and results, including wikis, blogs and code-sharing platforms (Williams et al., 2017).

There were about 28.100 active scholarly peer-reviewed English-language journals in 2014, collectively publishing approaching 2.5 million articles a year were published in 2013 by a total of 4.16 million unique authors. Total authorships were 10 million because each article had an average of 4.2 authors. They are just part of total cohort of active researchers which number varies by definition used but is estimated to be between 6.7 and 8.9 million (Plume, 2014). UNESCO has calculated that only around 1 million of all researchers were unique repeat authors, while only 2.5 million authors published at least once over a 5-year period (Mabe, 2002). Tenopir and King reported that although only 10 to 20% of the scientists in the United States are employed in universities they account for about 75% of articles published (King, 2004). A more recent study looked at the most productive authors, defined as those who had published at least once every year over the 16-year period under study (1996–2011). It found 15.2 million publishing scientists of which just 150.608 (or less than 1%) managed to publish a paper every year. This less than 1% of them were responsible for 42% of papers and 87% of the very highly cited papers (Ioannidis et al., 2014).

Although not every download will translate into a full reading, it is estimated that annual downloads of full text articles from publishers' sites are about 2.5 billion with perhaps another 400 million downloads from other sites such as repositories. Important question is how big is visibility and impact of

them? One of commonly used measures of article impact is citedness or on the other hand uncitedness. If we start from the fact that the average scientific paper takes its authors 90–100 hours to prepare (King, 2004), and two to three reviewers have to then spend an average of 3–6 hours each on peer review (Ware, 2008), should unread or uncited paper be considered as waist of human resources, energy and time both of authors, editors and publishers? Do we need so much small publishers in the light of the fact that 95% or more small publishers publish only one or two journals, while at the other end, the top 100 publishers publish 67% of all journals? (And if citing sources not only points the way for other scholars and give credit to others for work they have done, but also citations relate to the way authors perceive the substance of their work and their position in the academic system, might manipulation with citation be expected to achieve some material and immaterial benefits, like accessibility to research grants, self-promotion on academic ladder and glorification and admiration among academics? Finally, can citation biases be considered more seriously than other problems of unethical practices (Khaled, 2016) such as ghost and guest authorship or hyper-authorship, plagiarism or research misconducts.

### *Aim and methods*

Uncitedness of worthless papers as well as self-citing, in-group citing and citing of unread, retracted or never published papers is challenging academic community. It is under scrutiny due to the impact of new technologies that have enhanced visibility and accessibility of academic publishing in digital era.

Aim of this article is to identify, critically evaluate and integrate the findings of relevant, high-quality individual studies addressing the trends of enhancement of visibility and accessibility of academic publishing in digital era through literature search, integrating analysis, induction and deduction for synthesis.

### *Results and discussion*

The dissemination of important research findings through the academic and scientific community begins with publication in peer-reviewed journals. Process is continued through citation of the original work in subsequent publications and the number of citations received by an article is viewed as a marker for the importance of the original research and is reflected in the impact factor of journals in which the original paper was published (Kulkarni et al. 2007).

The number of citations a paper receives is often used as a measure of its impact and by extension, of its quality. The use of citations as a proxy for impact or quality has been extended from articles to journals with the impact

factor. Furthermore, Chalmers (2009) is treating those papers without impact as "waste in the production and reporting of research evidence" (Chalmers, 2009). The most-cited paper of all time is the paper by Oliver Lowry describing an assay to measure the concentration of proteins (Lowry, 1951). By 2014, it had accumulated more than 305.000 citations. The 10 most cited papers all had more than 40.000 citations. But at the same time of Thomson Reuter's Web of Science database with more than 58 million items and only approx. 0.026% had more than 1.000 citations in 2014 (van Noorden, 2014). According to Wabe, the distribution of citations follows the widely found Pareto pattern, with about 80% of citations coming from about 20% of articles. For example, Scopus data for citations to 2008 articles made in 2008–2012 showed almost exactly this result, while 32% of papers remained uncited (Wabe, 2015; Elsevier, 2013). Although 32% of papers that remained uncited is number far away from widely held belief that most of scientific articles are never cited, what has been established in a methodologically flawed piece of work (Hamilton, 1990, 1991) and is periodically non-critically reproduced in ambiguous literature, uncited papers and articles are uprising as important issue in academic and publishing community. It is also important to clearly explain that "cited papers" are papers published in a given year that received at least one citation two and five years after publication, but it is always open possibility that they will be cited in the future. Citing is time depending parameter and citation ageing vary by research fields, document types, publication months, and total citations (Wang, 2013).

The extend of 50% of articles "that were never read by anyone other than their authors, referees and journal editors" (Meho, 2007, 32) is very high no matter to confusion over precise figures. Furthermore, Meho s pointed out „sobering fact that some 90% of papers that have been published in academic journals are never cited“ (Meho, 2007, 32). Even if it is hard to accept that numbers and connect them with proved data, non-citation rated vary enormously by authors and scientific field but it might be close to about 82% of papers in humanities, 32% in social sciences, 27% in natural sciences and 12% medical field remain uncited (Lariviere, 2009). But citation counts do not mean that a more cited work is of a higher quality or accuracy than a less cited work because citations do not measure the quality or accuracy. Citations do not mean that a highly cited author or journal is more commendable than a less cited author or journal (Khaled, 2016).

Many aberrations of the citation practices have been reported in the attempt to increase impact of someone's paper through manipulation of citation, including for example honorary or reciprocal citations, as well as self-citation, inter-citation and cartel citation. Multiple inherent biases related to above-mentioned citation practices make citation-based bibliometrics strongly flawed and defective measures (Khaled, 2016).

Khaled used data from Greenland and Fontanarosa (2012) to formulate a statement that honorary citations are tightly related to honorary authorship that may reach up to 25% of research reports and 15% of review articles. Reciprocal citation is a practice when some authors tend to cite publications of people who cite their own work more than those who do not. In an analysis of about 50,000 papers published in the journal *Science*, it was reported that authors who cite the work of other authors are more likely to find their own work cited, in turn (Corbyn, 2010).

Discriminatory citations occur when some authors tend to superciliously cite papers only from specific journals, resulting in a substantial increase in their impact factors. Negative discrimination is connected with lower citation of woman authors or non English speakers (Khaled, 2015).

Coercive citation is an unfair academic publishing practice in which an editor of an academic journal forces an author to add spurious citations to an article before the journal will agree to publish it. This is done to inflate the journal's impact factor, thus artificially boosting the journal's scientific reputation. The results of a 2012 survey indicate that about 20% of academics working in economics, sociology, psychology, and multiple business disciplines have experienced coercive citation (Willhite, 2012).

Whenever citations are used as indicators to evaluate scientific research, self-citations (papers in which the citing and cited paper have at least one author in common) should not only be considered as only vanity, egotism or an attempt in self-advertising, but also as tactical tool in the struggle for visibility and scientific authority, and should be considered problematic because self-citations do not necessarily reflect the importance of someone's work or its impact on the rest of the scientific community. But the evidence of Fowler's macro study suggested that self-citation does pay – the more one cites oneself the more one is cited by other scholars and “if each self-citation yields an additional 3.65 citations from others after ten years that means an additional 40% of total citations may be generated indirectly by self-citations and self-citation may therefore account directly or indirectly for more than half of all citations after 10 years” (Fowler et al., 2007, 434).

Many other authors have studied self-citation and concluded that self-citations should be removed from citation counts (Glänzel, 2006, Thijs, 2006). The proportion of direct self-citation that is relatively constant varying between 10% and 36% with strong variations between specialties (Wallace et al., 2012).

Aksnes (2003) studied almost 40,000 publications by Norwegian authors and showed that using a three-year citation window was found that 36% of all citations represent author self-citations, percentage was decreasing when citations were traced for longer periods, with the highest share of self-citation among the least cited papers. There was a strong positive correlation between the number of self-citations and the number of authors of the publications:

articles with one author receive 1.15 self-citations on average, but articles with 10 authors receive 6.7 (Aksens, 2003).

Approaching the field of biomedicine, Gami has analyzed articles about diabetes mellitus in clinical journals in the year 2000 and found out that nearly one-fifth of all citations to were author self-citations (18%) and concluded that those findings were likely applicable to the general clinical medicine literature and had important implications for the assessment of journal or publication importance and the process of scientific discovery (Gami, 2004). Fassoulaki had investigated self-citations in issues of six anesthesia journals and found out the range of self-citing rate from 11% – 57% as well as the significant correlation between self-citing rates and impact factors was found ( $r = 0.899$ ,  $P = 0.015$ ) (Fassoulaki, 2000). According to Kulkarni (2011), approximately 1 in 15 citations of articles in high-profile general medicine journals are author self-citations that peaks within about 2 years of publication and disproportionately affects impact factor. Studies most vulnerable to this effect are those with more authors, small sample size, and in cardiovascular medicine or infectious disease (Kulkarni et al., 2011).

Davarpanah found that in general and internal medicine, self-citation accounted for about 16% of all citations, lower than organic chemistry, plant sciences, and electronic engineering (Davarpanah et al., 2009).

Thomson Reuters currently takes action and sanction journals (put them in "time out") when they show a strong pattern of self-citation, but the line of acceptable behavior is largely arbitrary. For example, one medical journal was de-listed from Thomson Reuters' Journal Citation Reports after more than 90% of citations involved in calculating their impact factor were coming from citations from its own papers (Davis, 2011).

For more than decades it is undisputed that more and more scientists tend to cite themselves as a result of egotism, for establishing their own scientific authority or to make their former works undesired more visible (Lawini, 1982). But, unfortunately, there is no significant penalty for the most frequent self-citers, and the effect of self-citation remains positive even for very high rates of self-citation (Nader Ale et al., 2010).

Honorary citation is also unfair practice when some authors tend to cite papers from their colleagues, supervisors or just people they know much more than other people. Discriminatory citations describe citing only papers from journals with specific high impact factors or practice connected with sexism when articles written by women are less cited (Khaled, 2016). Reciprocal citation was already proved through fact that authors who cite the work of other authors are more likely to find their own work cited in turn (Khaled, 2016).

Inter-citation is implying to existence of many patterns and complex connections in citation networks like for example reciprocal cross citing between related journals belonging to the same publisher, or more complex patterns. Ci-

tation networks describe relationships between researchers, papers connected with reasonable citation relationships, and they are a useful way for analyzing the hidden relationships. Dependence on citation counting as a measure for personal position in academic society and prerequisite for many incentives could result in a coercive self-citation where journal editors coerce authors into bolstering their citation counts by requiring that unnecessary journal references be added to a manuscript prior to acceptance (Franck, 1999; Davis, 2012). Furthermore, in San Francisco Declaration on Research Assessment has been stated that Journal Impact Factors can be, or to be more direct, – are manipulated by editorial policy. Also data used to calculate the Journal Impact Factors are neither transparent nor openly available to the public (DORA, 2013). Willhite reported that one in five respondents described being coerced by editors, and while the vast majority of respondents (86%) viewed citation coercion as inappropriate behavior, more than half (57%) indicated that they would consent to the request (Willhite, 2012).

The most dangerous errant behavior are citation cartels described as groups of authors that cite each other disproportionately more than they do other groups of authors that work on the same subject (Fister et al., 2016). The concept of citation cartels was firstly exposed in 1999 in an essay by Franck who defined this phenomenon as groups of Editors and Journals working together for mutual benefit. Franck definition referred to Editors that were using the inter-journal cites to increase the Impact Factors of their Journals As he explained, “There are ways of accumulating citations that have little to do with scientific value. The simplest way of circumventing the hurdle of productivity enhancement is the formation of citation cartels” (Franck, 1999, 53).

According to Fister, the citation cartels have also addressed other relationships, like Editor to authors or authors to authors and the cartels imply an easy way to obtain scientific excellence by increasing the number of one’s own citations (Fister, 2016). Cartels work by influencing incoming citations from other journals, so they are difficult to detect. Fister et al. have opted not to show specific results in this early phase of their study and felt the need to be certain before issuing accusation of involvement in a cartel. Thomas Reuters specifically uses the term “citation stacking” as opposed to “citation cartel,” to avoid issuing false accusations without certainty of intent (Enago Academy, 2017).

As an illustration of the citation cartels Davis (2012) described atypical citation patterns between four biomedical journals as first case of a citation cartel, and later in 2016 cartel between two biomedical journals damasking the role of Applied Clinical Informatics in distorting the citation performance of Methods of Information in Medicine through being involved in two retrospectives, observational studies on recent publications from both journals (Davis, 2016). Classic example was a review article (Eve, 2010) that was published in the Medical Science Monitor citing 490 articles, 445 of which were to papers pub-



lished in Cell Transplantation. All 445 citations pointed to papers published in 2008 or 2009. Of the remaining 45 citations, 44 cited the Medical Science Monitor, again, to papers published in 2008 and 2009 and of the four authors of that review, three were members of the editorial board of Cell Transplantation, which had seen phenomenal growth of its impact factor between 2006 and 2010: in 2006 it was 3.482 while in 2010 it had almost doubled to 6.204. (Davis et al. 2012). In the same year, 2010, two of these editors also published a review article (Park, 2010) in The Scientific World Journal citing 124 papers, 96 of which were published in Cell Transplantation in 2008 and 2009. Of the 28 remaining citations, 26 were to papers published in The Scientific World Journal in 2008 and 2009 (Davis et al. 2012). Similar cartel citation had been discovered through proliferation of papers by Serbian authors in two Bosnian WoS indexed journals (Šipka, 2012), two European journals in the field of soil science (Kleis, 2017) or in four Brazilian journals that had published seven review papers with hundreds of references to previous research (2009–10) in each other's journals what raised their 2011 impact factors.

Despite the fact that a small percentage of journals and authors have been discovered to take part in citation cartels, this practice damage the validity of the impact factor and the reputation of scientific literature. This behavior is also called "impact factor mania" and it persists because it confers significant benefits to individual scientists and journals. According to Cassadeval impact, factor mania "is a variation of the economic theory known as the 'tragedy of the commons,' in which scientists act rationally in their own self-interests despite the detrimental consequences of their actions on the overall scientific enterprise" (Cassadeval et al., 2014, e00064-14).

The science world is plagued by citation cartels, but however large the cartel phenomenon, it's just one among many illnesses afflicting modern science, which tends to reward quantity of metrics — more citations, more papers, more grant money — over quality (Oransky, 2017).

Symptoms of that contagious plague could be also visible through "citation inflation" — increase in the average citations per article. The numbers of citations are increasing faster than publications. Ware has compared the five-year periods 1999/2003 and 2004/2008 and found out that the number of publications increased by 33%, while citations increased by 55%. In addition, the trend in average citations per article for the period 1992–2012 for all countries has risen from about 1.7 in 1992 to 2.5 in 2012 (Ware, 2015).

Authors revenues to legally extend visibility, awareness and accessibility of their research outputs with uprising in citation and amplifying measurable personal scientist impact has strongly been enhanced by on line communication tools like networking (LinkedIn, Research Gate, Academia.edu, Google Scholar), sharing (Facebook, Blogs, Twitter, Google Plus) media sharing (Slide

Share), data sharing (Dryad Digital Repository, Mendeley database, PubMed, PubChem), code sharing, impact tracking etc.

Open access publishing has opened a new era in research work visibility and has important implications for academia, for university librarians, and even more so for the scientific, technical and medical publishing industry. By 2014. more than 50% of the papers published in peer-reviewed journals could have been downloaded for free Open access in three most important forms (ICE, 2017):

Green OA (Self Archiving) – authors publish in any journal and then self-archive a version of the article for free public use in their institutional (organization's) repository, in a central repository, or on some other OA website.

Gold OA – authors publish in a journal that provides immediate OA to all of its articles on the publisher's website. The journal is funded by a payment, commonly referred to as an article publication charge (APC), paid by each author at acceptance (rather than by annual subscriptions).

Hybrid OA – journal provides Gold OA for individual articles for which their authors (or their author's institution or funder) pay an APC. All other content resides behind a subscription barrier.

The entire OA publication model continues to expand rapidly with incensement of available papers by 9.4% per year. According to Archambault study from 2014. in the fields with the greatest proportion of OA were General Science and Technology (Adjusted OA=90%), Biomedical Research (71%), Mathematics and Statistics (68%), and Biology (66%). OA was not as commonly used in Visual and Performing Arts (Adjusted OA=25%), Communication Textual Studies (31%), Historical Studies (34%), Engineering (35%), and Philosophy and Theology (35%). Green OA was particularly present in physics and astronomy (25.6%), mathematics and statistics (24.3%), economics and business (11.3%) of papers in Green OA. Gold OA availability was greatest in general S and T (58%) and lowest in general arts, humanities social sciences (2.6%), and visual and performing arts (2.8%), built environment and design (3.5%) and engineering (4.1%). Other fields with high availability in Gold journals included biology (17%), agriculture, fisheries and forestry (16%), and public health and health services (16%). Other forms of OA were frequently encountered in biomedical research (48%), psychology and cognitive sciences (43%), biology (42%), earth and environmental sciences (38%), and clinical medicine (35%). For biomedicine, it is important to point out that, according to Archambault study, out of the 4.6 million scientific papers from peer-reviewed journals indexed in Scopus during the 2011–2013 period, 2.5 million were available free in 2014. A very large number of papers were freely available in clinical medicine (680.000 pa-

pers), biomedical research, physics, and astronomy (close to 250.000 papers) (Archambault et al., 2014).

Many studies and review articles in last decade have examined whether open access (OA) articles receive more citations than equivalent subscription toll access (TA) articles and most of them lead to conclusion that there might be high probability that OA articles have the open access citation advantage (OACA) over generally equivalent pay-for-access articles in many, if not most disciplines.

The first study published about open access citation advantage analyzed 119.924 computer science articles and found a 157% increase (2.5 times more likely) in the mean number of citations of OA articles over non-OA and concluded that free online availability substantially increases a paper's impact (Lawrence, 2001).

Five years later Eysenbach found out that open access articles twice as likely to be cited and were more heavily cited than non-OA articles (Eysenbach et al., 2006).

According to Archambault, who analyzed 1 million peer-reviewed journal articles indexed in Scopus from 1996-2013, OA papers are between 26% and 64% more cited on average for any given years than all papers combined, whereas non-OA received between 17% and 33% fewer citations. Furthermore, on average, Green OA papers have the greatest citation advantage being cited 53% more frequently than all papers, followed by Other OA, 47% more frequently, followed by Gold OA, which has a citation disadvantage of 35% on average, compared to a disadvantage of 27% for non-OA papers (Archambault et al., 2014).

In 2011 a sample of 12,354 original research articles which were published in 93 Oxford Open journals in 2009 have shown that Medicine, Math/Physical Sciences, and Life Sciences all showed an OACA ranging from 52% to 83% (Xu et al., 2011). According to Antelman Web of Science citation rates are enhanced for OA articles over non-OA articles by 91% for mathematics, 51% for electrical and electronic engineering, 86% for political science) and 45% for philosophy (Antelman et al., 2004). Hajjem claimed that open access articles had a citation impact advantage varying from 25% to over 250% in 4 disciplines and 28 subspecialties (Hajjem et al., 2005). Brody justify consistent citation advantage of OA articles over Non-OA articles published in the same journal and year ranging from 80% to 200% across 12 years of articles in physics and mathematics (Brody et al. 2004). In addition, the same author found out that articles self-archived by authors receive between 50-250% more citations (Broady et al., 2007). Greyson has analyzed 1,923 articles from four health care journals and concluded that OA archived articles were 60% more likely to be cited at least once and, once cited, were cited 29% more than non-OA articles (Greyson et al., 2009). The Journal of Postgraduate Medicine showed a remarkable

365% increase in citations per article after switching to open access (Sahu et al., 2005). A study of 11 biological and medical journals that contain both open access and subscription access articles that indicates a citation advantage for open access articles of 17% (Davis, 2009). Zhang compared web citations from peer-reviewed articles and informal web sources to an open access communications journal and a subscription communications journal. The OA articles received twice as many web citations than the subscription articles and what is also important received a greater percentage of web citations from developing countries.

Some explains may be in the fact that open access articles are downloaded far more than toll access articles, and download advantage is easily 100% over toll access articles. More downloads might lead to more citation (Wagner et al., 2010). It has to be discussed are authors making self-selection of higher quality articles for OA that leads to Quality or Selection bias, as well as how big is the influence of earlier dissemination via preprints/OA repositories that leads to early access bias (Wagner et al., 2010). There studies have shown that citation advantage for OA self-archiving is independent of journal impact factor, article age, and number of co-authors (Harnad et al., 2007).

It has been proven that multiple open access availability has positive impact on its citation count with possibility that for every unit increase in the availability of OA articles, citation numbers increase by 2.348 (Xia et al., 2011).

Furthermore, OA articles are downloaded and read three times as much as non-OA articles, and there is a positive correlation between early download counts and later citation counts (Harnad et al., 2006). Wang founded that average article page views were 2.5 to 4.4 times higher for OA articles and the OA page views were much more sustained and steady over a much longer period than non-OA articles (Wang et al., 2015). There are also few studies that found no significant effect of open access. Authors believe self-selection of higher quality articles into open access explains at least part of the observed open access citation advantage (Davis et al., 2010, 2011).

Finally, even if the OACA is minimal or non-existent, citation advantage there are a number of other reasons to publish OA including benefiting teachers, students, practitioners, the general public, and researchers in less developed countries or working for small organizations by removing access barriers while maintaining more control and free use of one's own work (Wagner et al., 2015). For Glasziou the role of open access is very important in reducing waste in research. For him open access is more than free access and includes free, immediate access online; unrestricted distribution and re-use rights in perpetuity for humans and technological applications (Glasziou, 2014).

Besides the citation data, open access publishing has opened a new era in research work visibility and has important implications for academia, for university librarians, and even more so for the scientific and medical publish-

ing industry and consequently strongly enhance discoverability and visibility through new networks, like social networks and new platforms and over 400 tools and innovations in scholarly communications that will enhance possibility to be cited in much more fair way.

Categories of new tools could be divided into several categories even they are overlapping in many layers: networking (LInkedIn, ResearchGate, Academia), idea sharing (blogs, WhatsUp, Twitter/Google Plus), media sharing (SlideShare, Youtube, Vimeo, Weibo), data sharing (Dryad Digital Repository, figshare and Mendeley database, preprint servers (arXiv, bioRxiv, ChemRXiv), code sharing (GitHub, SourceForge), publication and citation tracking (ORCID, Google Scholar, and Microsoft Academic Search), organizational impact (Kudos; Altmetrics; ORCID), alternative impact tracking (ImpactStory, Altmetric, PlumX, ResearchGate score) and research amplification (Kudos) (Williams, 2017).

Examples of the increasing importance of these non-traditional sources of scientific information, according to Williams (2017) is the increasing prevalence of links to Wikipedia, blog posts and code-sharing in reference lists associated with references in scientific publications (~35,000 citations to Wikipedia, ~11,000 for YouTube, ~10,500 for Facebook, and ~7000 for Twitter) (Williams, 2017). Especially Tweets have a potential to develop for scientific idea dissemination having in mind that every second on average, around 6,000 tweets are tweeted on Twitter, which corresponds to over 350,000 tweets sent per minute, 500 million tweets per day and around 200 billion tweets per year with the volume of tweets growing at around 30% per year, as well as WhatsApp with 1.3 billion monthly active users and constant grow.

Despite the prevalence of new social media, networking, data sharing, tracking and amplification as research activity distribution tools, the vast majority of scientists do not use these tools to enhance sharing, evidencing and amplifying their scientific research (Collins et al., 2016) even that could help some researchers to promote their works even they had already published in OA source. Eysenbach (2011) had analyzed metrics of social impact based on twitter and correlation with traditional metrics of scientific impact and found out that highly tweeted articles were 11 times more likely to be highly cited. Tweets showed also moderate correlation strength with Google Scholar, but not with Scopus because Google Scholar indexes many non-article sources (Eysenbach et al., 2011), although there might be some methodological and interpretive problems (Davis, 2012b).

Many publishers and digital libraries nowadays are providing article-level usage data to public, as well as article views data on daily level so called "dynamic usage data" that allows to trace the real time research trends, even to predict number of downloads and citation (Wang et al., 2014). Altimetric data are extremely useful to track the influence of an institutions work on public policy and helps provide insight into value of research outputs. It has been

proved the open access advantage considering citation (open access leads to obvious citation advantage), article usage (for article downloads, non-OA papers only have a short period of attention, when the advantage of OA papers exists for a much longer time) and social media attention (a slightly higher Twitter and Facebook activity for OA articles) (Wang et al., 2015).

Several papers have compared number of citation in Web of Science compared to either Scopus, and/or Google scholar, Google, ResearchGate or Academia.edu. Niyazov found out for all types of publication the median number of citation is highest in the Google Scholar, that is greater than median number found in Web of Sciences, while paper in a median impact factor journal uploaded to Academia.edu receives 16% more citations after one year than a similar article not available online, 51% more citations after three years, and 69% after five years (Niyazov et al., 2016).

Compared to Academia.edu, ResearchGate as multidisciplinary academic social website that aims to help academics to connect with each other and to publicize their work. ResearchGate has indexed impressively many citations for a single website and has become a major source of academic papers, but still found less citations than did Google Scholar but more than both Web of Science and Scopus. ResearchGate has also launched its own citation index by extracting citations from documents uploaded to the site and reporting citation counts on article profile pages. Since authors may upload preprints to ResearchGate, it may use these to provide early impact evidence for new papers. (Thelwall, 2017). But it also has to be considered that about half (51%) of the 78% user-uploaded articles that are not open access violate publisher copyright agreements (Jamali, 2017).

Vaughn has compared citation of 1.483 publications in Web of Science (WoS), Google, and Google Scholar. Google Scholar citations had a stronger correlation with WoS citations than did Google citations. With 92% of Google Scholar citations representing intellectual impact, it has considerable potential to become the primary source for measuring research impact (Vaughn, 2007). It has also been investigated are Wikipedia citations important evidence of the impact of scholarly articles and books. The results show that citations from Wikipedia to articles are too rare for most research evaluation purposes, with only 5% of articles being cited in all fields (Thelwall, 2017). According to Williams (2017) investing additional efforts into sharing data, research outputs or the final published products of the research work, may directly benefit a scientist's career leading to new collaborations, new funding or even facilitate new discoveries (Williams, 2017).

## *Conclusion*

"Publish or perish" phrase usually used to describe the pressure in academia to rapidly and continually publish academic work to sustain or further one's career (Garfield, 1996) can now be reformulate into "Publish and be cited, not to Perish" even though multiple inherent biases related to different citation practices like self-citations, circumstantial citations, as well as negative citations, wrong citations, multi-authorship-biased citations, honorary citations, discriminatory citations, selective and arbitrary citations, etc. make citation-based bibliometrics strongly flawed and defective measures (Khaled, 2016).

Scientists by using self-citation tend to cite themselves for many reasons, not only to make their former works visible but also to feed their egotism, to establish and upgrade their own scientific authority, but this attempts and hidden motivation are relatively easy to discover if wanted. On the other hand, circular citation, inner citation and citation cartels as tactical fraud in the struggle for visibility and undeserved scientific authority and promotion are not only morally problematic but illegitimate no matter that there is no significant penalty for the most frequent self-citers or circle and cartel members. Therefore, effects caused by self-citations and other pernicious academic behaviour should be carefully considered. Using citations as indicators of scientific impact is already distorted and using quantity of cites as a proxy for quality or visibility is seriously reduced. Also, the practice of correlating the journal impact factor to the merits of a specific scientist's contributions should not only be questioned, but stopped. Journal impact factor is wrongly and frequently used as the primary parameter with which to compare the scientific output of individuals and institutions what is bad practice because the Journal Impact Factor, as calculated by Thomson Reuters, was originally created as a tool to help librarians identify journals to purchase, not as a measure of the scientific quality of research in an article (DORA; 2013). According to DORA, the Journal Impact Factor has a number of well-documented deficiencies as a tool for research assessment. Having all above mentioned in the mind, authors opinion is that uncited papers are not "Worth(less) papers". According to Khaled (2015) a paper may remain shelved or overlooked for years or decades, but new studies or discoveries may actualize its subject at any moment. The fact that a paper remains uncited is not necessarily a true indication of its worth, and it does not mean they have been unread or unnoticed as well as they will not be cited in the future. Citation counts do not mean that a more cited work is of a higher quality or accuracy than a less cited work because citations do not measure the quality or accuracy. Citations do not mean that a highly cited author or journal is more commendable than a less cited author or journal. As Khaled clearly concluded "citations are not more than countable numbers: no more, no less" (Khaled, 2015, 230). According to Remler the uncited rate is also sensitive to many other

factors. It is important to follow how long a window is used to check for citations, when the article whose cites are being counted was published (2000s or 1990s) and what counts as a citation (Remler, 2014). Authors completely support Altmans opinion about inherent mistake in the system itself that encourages poor research and appeal that the system that should be changed. Almost 25 years before it was already pointed out by Altman that we need less research, better research, and research done for the right reasons. Abandoning using the number of publications as a measure of ability would be a start (Altman, 1994).

For that reason, journal-based metrics, such as Journal Impact Factors and number of citations are not suitable indicators to evaluate quality of scientists and should no more be used as a surrogate measure of the quality of individual research articles, to assess an individual scientist's contributions, or in hiring, promotion, or funding decisions. The scientific content of a paper is much more important than publication metrics or the identity of the journal in which it was published.

Institutions should redefine criteria used to reach hiring, tenure, and promotion decisions. Funding agencies should redefine their criteria for evaluating the scientific productivity of grant applicants. Finally, much more important should be responsible authorship practices and the provision of information about the specific contributions of each author then just information about number of cites or how high is the journal impact factor. The most important change should be made in consideration and valuation of a broad range of impact measures including qualitative indicators of research impact, such as influence on policy and practice (DORA, 2013). Then quality will again be much more important than quantity – number of papers, number of cites and journal impact factor. Finally, academic honesty and moral values will be rediscovered and revalued again (American Society for Cell Biology, 2013). This includes rapid change in the practice where grad students and postdocs are exploited to do research and write journal articles for their supervisors just to get credit as 'second' author (Vossen, 2017, 123). Open access publishing has opened a new era in research work visibility and has important implications for academia, for university librarians, and even more so for the scientific and medical publishing industry and consequently strongly enhance discoverability and visibility through new networks, like social networks and new platforms that will enhance possibility to be cited in much more fair way. Despite the prevalence of new social media, data sharing and research activity distribution tools, the vast majority of scientists do not use enough these tools to enhance sharing, evidencing and amplifying their scientific research even it is unquestionable in our present time that the sharing, networking and outreach of research work could bring mutual benefits to scientist's career and humanity through new collaborations, new funding and new discoveries.

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»(Bez)vrijedni radovi« – jesu li faktor odjeka časopisa i broj citata adekvatni indikatori za evaluaciju kvalitete znanstvenika?

### Sažetak

Promjene pokretane tehnologijom koje posljedično dovode do uzastopnog povećanja on-line dostupnosti i pristupljivosti časopisima i znanstvenim radovima ubrzano mijenjaju obrasce akademske komunikacije i publiciranja. Širenje važnih otkrića u znanstvenoj zajednici počinje objavljivanjem u recenziranim časopisima. Svrha je ovoga članka prepoznati, kritički procijeniti i integrirati nalaze relevantnih, visokokvalitetnih individualnih studija koje se bave trendovima povećanja vidljivosti i pristupačnosti akademskoga izdavaštva u digitalnom dobu. Rezultati i diskusija: Broj citata koja pojedini znanstveni rad dobiva često se koristi kao mjera njegova utjecaja, a šire shvaćeno i njegove kvalitete. Zabilježene su mnoge aberacije u praksi citiranja kroz pokušaje povećanja utjecaja nečijega znanstvenoga rada manipuliranjem sa samocitiranjem, inter-citiranjem i udruživanjem u »citatne kartele«. Mogući putovi kojima bi autori mogli legalno povećati vidljivost i dostupnost svojih istraživačkih rezultata, s povećanjem broja citata i pojačavanjem mjerljivoga odjeka utjecaja, kako rada tako i znanstvenika, snažno su poboljšani on-line komunikacijskim alatima kao što su umrežavanje (LinkedIn, Research Gate, Academia.edu, Google Scholar), dijeljenje (Slide Share), dijeljenje podataka (Dryad Digital Repository, Mendeley database, PubMed, PubChem), dijeljenje koda, praćenje veličine utjecaja (Facebook, Blogovi, Twitter, Google Plus), te objavljivanjem u časopisima otvorenoga pristupa. Mnogi znanstveni i pregledni radovi u posljednjem desetljeću ispitali su hoće li se radovi objavljeni u časopisima s otvorenim pristupom više citirati u odnosu na radove objavljene u časopisima koji naplaćuju pristup, te većina rezultata upućuje na zaključak da bi mogla postojati komparativna prednost pri citiranju radova objavljenih uz otvoreni pristup u odnosu na drugu skupinu časopisa u mnogim, ako ne i u svim područjima znanosti. Ostaje upitno jesu li radovi koji ne budu nikad citirani doista i »bezvrijedni radovi«, te jesu li su faktor odjeka časopisa i broj citata doista jedini adekvatni indikatori za evaluaciju kvalitete znanstvenika? Zaključak: Frazu »Objavi ili nestani«, koju se obično koristi za opisivanje pritiska na članove akademske zajednice da brzo i neprekidno objavljuje znanstvene radove za održavanje ili napredak u daljnoj karijeri, u 21. stoljeću se može preoblikovati u »Objavi i budi citiran, da možda ne bi nestao.«

*Gljučne riječi: citiranje, samocitiranje, citatni karteli, otvoreni pristup, pristupljivost, vidljivost, nove tehnologije.*

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