Validation of Journal Impact Metrics of Web of Science and Scopus

Syed Rahmatullah Shah
University of Boras, Sweden
University of the Punjab, Lahore, Pakistan
Email: rahmatgee@yahoo.com

Khalid Mahmood
University of the Punjab, Lahore, Pakistan
Email: khalid.im@pu.edu.pk

Citation based metrics are widely used to assess the impact of research published in journals. This paper presents the results of a research study to verify the accuracy of data and calculations of journal impact metrics presented in Web of Science (WoS) and Scopus in the case of three journals of information and library science. Data collected from the websites of journals were compared with that of two citation extended databases. The study manually calculated the Journal Impact Factor (JIF) and the Impact per Publication (IPP) in accordance with formulas given in the databases. Data were also collected from the Google Scholar to draw a comparison. The study found discrepancies in two sets of data and bibliometric values, i.e., systematic values presented in WoS and Scopus and calculated in this study. Commercial databases presented inflated measures based on fabricated or erroneous data. The study is of practical importance to researchers, universities and research financing bodies that consider these bibliometric indicators as a good tool for measuring performance, assessment, and evaluation of research quality as well as researchers.

Keywords: Citation analysis; Journal rankings; Journal Impact Factor; Impact per Publication; Scholarly communication; Bibliometrics.

INTRODUCTION

Citations are a valuable source for researchers, librarians, publishers and scientific and academic organizations. They use citations as a measure for quality of research output and evaluation of a research journal (Moed, 2005). Researchers use citations to look into the flow and development of ideas in their research. They check accuracy, originality, authenticity, influence, and other relevant facts about ideas related to their own studies (Garfield, 1964; Salton, 1963). Researchers strengthen their ideas on the bases of citations to highlight the existing research and the presence of gaps to be filled in by their own studies (Moed, 2005). Citations also serve the purpose of lending intellectual credits to the real contributors in research. They also safeguard the rights of the researcher who originally initiated or developed an idea (Day, 2014; Merton, 1957). Librarians have a long history of using citations as a tool in making comparisons of two or more published journals covering the same discipline or subject category. Their use of citations helps utilize the limited financial resources. Therefore, librarians use citations to draw a comparison and decide which journals should be acquired from a wide variety available amongst researchers in a particular subject (Moed, 2005).

Publishers started to bring out citations data similar to their product catalogues that facilitate librarians in making quick decisions. Citations data produced by publishers came into the use of researchers that opened new horizons for both, publishers and researchers (De Bellis, 2014). Information and communication technologies, such as internet and web technologies, added value to production and utilization of citations data. Various reference and citation extended databases, such as Web of Science, Scopus and Google Scholar, emerged to facilitate researchers and librarians. Despite limiting their role to citations data, these web-based automated systems introduced a number of other metadata related solutions such as research impact matrices and indices. The use of these numeric measures of research impact drew the attention of research financing authorities, administration of universities and research organizations, research funding, awards and reward councils, selection boards, appointing authorities, and others of similar characters and roles. These new beneficiaries used citations data as a measuring tool for the researchers' performance as a measure of research, and to evaluate journals (Blaise, 2014).

In spite of the undeterred wider use of citation based measures there is plenty of literature that criticizes the application of such metrics to evaluate the quality of research. In addition to non-discrimination of positive or negative citations, the use of citations has serious disadvantages for researchers, publishers, and institutions and research itself (Wouters, 2014). Researchers face the stress of publishing more research articles as proof of their performance. Their financial benefits, such as increments, awards, job tenures, new appointments, and promotions, are unduly linked to these citation based measures (De Bellis, 2014;

Wouters, 2014). The final effect manifests itself in the form of researchers' employing smart tactics to counter citation issues at the cost of research and knowledge (Wouters, 2014). The research publications industry faces issues related to franchising and monopolizing trends (Blaise, 2014).

Editors of research journals are forced to publish research in a strategic way. Their survival and promotional efforts opens them up to biases and a questionable publication system of research. Academic focused institutions lag behind in securing competitive public funds. Therefore, academic institutions increasingly become research focused to strengthen their position in a race of research and development fund competitions (Wouters, 2014). Citation impact and other metrics are calculated on the basis of 'citable items' in Web of Science (WoS) and 'citable documents' in Scopus (Nelhans, 2014). However, not one from the empirical studies and research literature supported publication counts, citation counts, and calculations on the basis of these numbers as a suitable tool for measuring the quality of research, performance of researchers and the resulting financial benefits.

Many earlier studies compared features offered by various citation extended databases (Bergman, 2012). There are also studies about the practical utility of these databases for a single information source (Bar-Ilan, 2010). Moreover, practical aspects of a single database were discussed. The aforementioned studies discussed various policy and methodological issues that were relevant to impact measures in ideal circumstances on the part of these citation databases. Some authors highlighted misconduct in these databases (Seglen, 1997). However, the researchers rarely endeavoured to validate the treatment of data by these databases and prove errors or malpractices on the part of databases empirically and in a transparent and verifiable way. The present study is an attempt to fill this gap in research literature.

Key Concepts

Web of science quality measures. Journal Impact Factor (JIF) and 5-year JIF are popular quality measures in Web of Science (WoS). These measures are based on the calculations of a number of citations in the preceding years. These citation calculations are limited to journals indexed in Web of Science, irrespective of the citations of articles in good or poor quality journals ("The Thomson Reuters Impact Factor," 1994). Journal Impact Factor (JIF) is calculated as under:

2014 Impact factor of journal = A/B

Numerator = A = Number of times all items published in that journal in 2012 and 2013 cited by WoS indexed publications in 2014

Denominator = B = Number of 'citable items' published by that journal in 2012 and 2013 ("The Thomson Reuters Impact Factor," 1994).

Similarly, 5-year Journal Impact Factor is calculated as:

5-year impact factor of journal in 2014 = a/b

Numerator = a = Number of citations in 2014 to articles published in 2009-13

Denominator = b = Number of articles published in 2009-2013 ("The Thomson Reuters Impact Factor," 1994).

Scopus quality measure. Impact per Publication (IPP) is one of the popular quality measures in Scopus. It leads to the calculation of Source Normalized Impact per Paper (SNIP) which is used as an alternative to the WoS Journal Impact Factor (Leydesdorff & Opthof, 2010). It is a ratio of citations to the number of published papers within the Scopus indexed publications ("About Impact per Publication (IPP)," 2015). Formula for calculation of IPP is given below:

IPP for year 2014 = X/Y

Numerator = X = 2014 citations in citable items published in 2011-2013

Denominator = Y = Number of cited items published in 2011-2013.

Citable item/citable document. 'Citable item' in WoS and 'Citable document' in Scopus serve the same purpose in two databases. The WoS considers articles (research articles) and reviews as citable items. Journal Citation Reports (JCR) of WoS considers only articles and reviews. Editorials, letters, news items, and meeting abstracts are excluded from the JIF calculations because they are not generally cited ("Journal Citation Reports," 2012). The Scopus includes conference papers among citable documents. Therefore, articles, reviews, and conference papers are citable documents in Scopus ("Journal Rankings," 2015).

LITERATURE REVIEW

Many studies mentioned systematic misconduct and un-ethical practices on the part of reference and citation extended databases. Seglen (1997) pointed out the wrong inclusion of citations of non-citable items in measuring the impact factor of research journals in JCR. He also mentioned an undue favour to literature of diminishing discipline in measuring JIF in addition to other biases of language and projection of American literature. The PLoS Medicine Editors ("The Impact Factor Game," 2006) identified that impact factor calculations were unscientific, arbitrary, and a hidden process. This process had enough space for editors to decrease the number of citable items that ultimately increased the impact factor of the journal. These editors contested that Thomson Reuters was not accountable to anybody for these manipulations in their completely non-transparent system. The editors stated, "during discussions with Thomson Scientific... it became clear that the process of determining a journal's impact factor is unscientific and arbitrary... we came to realize that Thomson Scientific has no explicit process for deciding which articles other than original research articles it deems as citable. We conclude that science is currently rated by a process that is itself unscientific, subjective, and secretive" (p. 707). Carrió (2008) also pointed that decision about citable items from hidden data was on the discretion of Thomson Reuters' officials.

Rossner, Van Epps and Hill (2007) contacted Thomson Scientific to inquire about the discrepancy in the data of a particular journal available in Web of Science and that were used for calculating the impact factor of that journal. They failed to access the actual data used for the impact factor. They concluded that scientists should not rely on a measure which was based on hidden data—in contrast to the basic principles of scientific inquiry. Binswanger (2014) was of the view that "a de facto monopoly for the calculation of impact factors... enables Thomson Scientific to sell its secretly fabricated Impact Factors to academic institutions at a high price" (p. 61). Brumback (2009) opined that "scientists should be outraged that the worth of science is being measured by a secretive proprietary metric that as often destroys as much as it aids careers and scientific initiatives" (p. 932).

Monastersky (2005) pointed out unethical practices by editors to increase impact factor of their journals. He stated that in addition to editors' undue managerial tactics, Thomson Reuters' management team modified numerator and denominator values in calculating impact factor. Published citable items are put into non-citable document categories that reduce the denominator value and increase impact. If any of these documents is cited, then its citation is added into the numerator value that results into an increase of impact factor. Thus, both increase in citations number and decrease in citable items increase impact factor of research journal. Many researchers have repeatedly raised their voices against this erroneous and unethical practice. (A considerable number of representative papers include Brumback, 2008; Campbell, 2008; Chew, Villanueva, & Van Der Weyden, 2007; Dong, Loh, & Mondry, 2005; Falagas & Alexiou, 2008; Frandsen, 2008; Glänzel & Moed, 2002; Jasco, 2001; Kumar, 2010 Law, 2012; Martin, 2016; Moed, Van Leeuwen, & Reedijk, 1999; Rousseau, 2012; Sevinc, 2004; Simons, 2008; Smart, 2015; Van Leeuwen, Moed, & Reedijk, 1999; Whitehouse, 2001; Wolthoff, Lee, &

Ghohestani, 2011; Zupanc, 2014).

We could find three studies that tried to audit the values of JCR impact factor. Golubic, Rudes, Kovacic, Marusic, and Marusic (2008) collected article and citation data from Web of Science for four journals from different disciplines, including *Nature*, and compared it with the number of citations and citable articles in JCR. They found that "items classified as non-citable items by WoS, and thus not included in the denominator of the IF equation, received a significant number of citations, which are included in the numerator of the IF equation" (p. 45). When they put their data into the impact factor formula the values decreased for all high-ranked and middle-ranked journals (between 12.2% and 32.2%).

Wu, Fu and Rousseau (2008) calculated data collected from WoS and predicted 2007 impact factors (IFs) for several journals, such as *Nature*, *Science*, *Learned Publishing* and some library and information sciences journals. In most of the cases they found lower values of the calculated impact factor than that of officially released by JCR. Law and Li (2015) selected three journals in the field of tourism and compared the number of citable articles given in JCR and the publisher's website (Sciencedirect.com). They found that JCR used a small number of citable articles for the calculation of impact factors as compared to the actual number.

> The discrepancies are likely due to the differences in data used. Another possibility for the discrepancy is that ScienceDirect used a categorization that is different from that used by Thomson Reuters, and that Thomson Reuters used a subjective and inconsistent way of categorization. Drawing on the findings of this study, Thomson Reuters could, and probably should, publish their categorization approach to make their IFs more credible (p. 21).

STATEMENT OF THE PROBLEM

Citation based quantitative metrics are widely used as surrogates for determining the quality of research published in journals. A large number of previous researchers have found errors and malpractices used to manipulate the calculation of these measures in order to project the journals as carriers of good quality research. Journal editors and the staff of citation extended databases have been involved in this unethical practice. However, very few studies audited values of the impact measures released by these databases with the help of independent data.

This study empirically validates research impact measures presented by Web of Science and Scopus. It investigates the authenticity, reliability, and trustworthiness of the quality measures. This research is an attempt to check and highlight, in a transparent as well as in a verifiable way, if there is any systematic misconduct in research impact measures presented by these two reference and citation extended databases. The primary research question addressed in study was, whether data and calculations of journal impact metrics are accurately presented in WoS and Scopus in the case of three journals of information and library science.

METHODOLOGY

In order to validate the journal quality measures provided by citation extended databases, we decided to compare the values with those calculated manually by us. We selected two databases, i.e., WoS and Scopus, and three research journals for this study. Selection of research journals was from WoS due to its limited coverage of journal titles as compared to Scopus. Subject category 'Information Science and Library Science' was selected from Web of Science (WoS) JCR index. Eighty-seven research Journals were indexed in this category. Three research journals were selected – one with the highest rank position, *MIS Quarterly* (USA, ISSN: 0276-7783, JCR rank: 1) and two from lower rank positions, *Library and Information Science* (Japan, ISSN: 0373-4447, JCR rank: 69) and *Malaysian Journal of Library and Information Science* (Malaysia, ISSN: 1394-6234, JCR rank: 71). Statistical data regarding quality measures were collected from citation databases. Data regarding citable items/documents were collected manually from official websites of respective journals, and data regarding citations were manually counted from the respective citing databases – WoS and Scopus. We used Microsoft Excel to calculate our own Journal Impact Factor, 5-year Journal Impact Factor, and Impact per Publication (IPP).

In addition to the comparison of WoS and Scopus, we collected citations data for five years on the pattern of WoS and Scopus from Google Scholar by using Publish or Perish (Harzing, 2007) software. Finally, three quality measures were calculated on the basis of Google Scholar data, but using the formulas of WoS and Scopus.

RESULTS & DISCUSSION

Journal Impact Factor (JIF) and 5-year JIF for three journals as per Journal Citation Report (JCR) are shown in table 1. These calculations are claimed to be the output of specific software used by Thomson Reuters. Therefore, it is systematically generated data and results are based on that data set. Similarly, there are manual calculations of JIF and 5-year JIF for the same journals in Table 2. Although results given in Table 1 and Table 2 are of same journals, for the same time period, and of specific number of citations yet there are notable variations in the data involved in calculating JIF and in the final metrics.

Table 1

Systematic data from Journal Citation Report (JCR) 2014

Journal	Total cites	Citable items	JIF	5-Year JIF
Library and Information Science	19	4	0.278	0.173
Malaysian Journal of Library and Information Science	90	20	0.238	0.455
MIS Quarterly	9,600	54	5.311	8.490

It was observed that none of these three journals had any missing issue in the years under study. Therefore, data missing cannot be assumed as a reason of variations in data sets and further results. The first issue is related to simple calculations of JIF from the given values in table 1. These calculations are wrong in all the journals. Secondly, in JIF calculations, any increase in citations (numerator) and any decrease in citable items (denominator) affect results in such a way that JIF and 5-year JIF scores increase. Total cites and citable items in tables 1 and 2 are significantly different. For instance, *Library and Information Science* is a semi-annual journal that published four issues in two years (2012-13). Systematic data in table 1 show only four citable items having 19 citations in all WoS indexed journals in 2014. But in the calculations for this study, as shown in table 2, there were 18 citable items that had just one citation in all WoS indexed journals in 2014. These variations in data sets completely changed the calculated JIF. Thus, the difference of JIF from 0.056 to 0.278 (about five times increase) in a subject of social sciences makes no sense for justification of WoS quality measures. The situation is the same for the other two journals. Furthermore, Table 1 presented very low number of citable items and very high number of citations for all journals as compared to Table 2 and the result was inflated JIF *scores presented by JCR.*

The values of Impact per Publication (IPP) as per data provided by Scopus are given in table 3. These calculations are the result of the software that is used by Elsevier in Scopus quality measures. Scopus provides raw data on its website for calculations of journal and publication impact measures. As explained by Scopus, these citations and documents data are periodically updated.

Table 2

Empirical data collected from journal websites and WoS

Journal	Citations (A) 2012	2013	5-year citations (2009-2013)	Citable items (2Y)	Citable items (5Y)	JIF	5-year JIF
Library and Information Science	0	1	4	B=18	b=52	A=1 B=18 IF=.056	a=4 b=52 0.077
Malaysian Journal of Library and Information Science	5	4	44	B=42	b=112	A=9 B=42 IF=.214	a=44 b=112 0.393
MIS Quarterly	432	213	1900	B=122	b=243	A=645 B=122 IF=5.286	a=1900 b=243 7.819

Table 3 presented data as per June 24, 2015 updates ("Compare Journals," 2015). Further, there are manual calculations of Scopus quality indicator (Impact per Publication—IPP), on the same method that was used by Scopus, in table 4. It was observed that results in table 3 are different from the results in table 4, similar to the situation, previously, in case of WoS quality measures.

Table 3

Systematic data from Scopus("Compare Journals," 2015)

Journal	Total Doc. 2014	Total Doc. (3Y)	Citable Doc. (3Y) = Y	Total Cites (3Y) = X	IPP = X/Y
Library and Information Science	16	67	62	12	0.117
Malaysian Journal of Library and Information Science	20	70	70	51	0.614
MIS Quarterly	6	178	171	2059	7.228

Scopus calculates Impact per Publication (IPP) as the ratio of three years citations to the number of citable documents. Table 3 shows that systematic calculations as per given data through official resources are wrong in case of all journals under study. In comparing systematic results to the manual results, there are difference between Scopus official values and those of manual calculations. For instance, citations of the year 2014 in all Scopus indexed journals from three year documents (2011-13) of *Library and Information Science Journal* were 12 as per Scopus official resources and only three as per manual calculations. Moreover, citable documents in three year period for this journal were 62 as per Scopus official data while 27 as per manual calculations. A similar situation emerged for other journals. Although the problem of inflated IPP is not seen in Scopus but one cannot depend on these erroneous calculations.

Table 4

Empirical data from journal websites and Scopus

	Total Cites (X)			Total Citable Docs. (Y)			
Journal	2011	2012	2013	2011	2012	2013	IPP = X/Y
Library and Information Science	2	0	1	9	7	11	3/27=0.111
Malaysian Journal of Library and Information Science	36	11	6	28	20	22	53/70= 0.757
MIS Quarterly	744	777	507	48	61	61	2028/170= 11.929

Table 5

Empirical data from Google Scholar

	Citable items/Doc.					Citations				
Journal	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Library and Information Science	14	11	9	7	11	7	1	3	0	2
Malaysian Journal of Library and Information Science	18	24	28	20	22	73	52	63	31	15
MIS Quarterly	36	37	48	61	61	952	1372	1546	1403	808

Data in table 5 came from Google Scholar and official websites of respective journals. The number of citations were calculated by using *Publish or Perish* (Harzing, 2007) software. Further, JIF, 5-year JIF and IPP were calculated with the help of Scopus and WoS formulas. Results are presented in table 6.

Unlike WoS and Scopus, Google Scholar has a wider coverage of documents. This database also considers a few other resources as documents that are out of scope from both WoS and Scopus. Three journal quality metrics based on data sets of Google Scholar (table 6) present another picture regarding the effects of an increase in the number of citations in a particular period of time based on the parameters of enhanced coverage of documents. It was observed that, contrary to official data sets and results (tables 1 and 3), manual calculations (tables 2 and 4) have, somehow, similarity to mechanically produced results through Google Scholar.

If we take *Library and Information Science* as an example, its WoS JIF is 0.278 (table 1). This impact factor could not be justified even on the basis of Google Scholar data that counted all possible citations in broader spheres in comparison to WoS. Even then impact factor of *Library and Information Science* is much lower (i.e. 0.111) Conversely, manual calculation of impact factor for *Library and Information Science* in this study give JIF value of 0.056 that is closer to the JIF from Google Scholar data. The result is similar for IPP calculations from Scopus system and manual for all journals.

Table 6

JIF and IPP scores based on Google Scholar data

Journal	JIF	5-year JIF	IPP
Library and Information Science	0.111	0.250	0.185
Malaysian Journal of Library and Information Science	1.045	2.089	1.557
MIS Quarterly	18.123	25.025	53.671

Data from Web of Science (tables 1 and 2) make it clear that in all these three research journals, the given number of citations is much higher (table 1) than the actual number of citations (table 2). Similarly, the given number of citable items is significantly lower than the actual citable items. Hence, impact factor scores are inflated. Scopus based data show that the given number of citations for each of these journals (table 3) was more than the actual number of citations (table 4). Also the given number of citable documents (table 3) is less than the actual citable documents (table 4). The results have been manipulated in the same manner. These findings indicate that quality metrics of Web of Science and Scopus are fabricated rather than tools for an impartial calculation and presentation of facts, as is generally assumed in research community.

Findings of the present study are in conformity with that of Golubic et al.(2008), Law and Li (2015), and Wu, Fu and Rousseau (2008) that WoS manipulates data to show higher values of impact factor for journals. Calculation of journal quality metrics based on the data from comparatively new citation extended databases, i.e., Scopus and Google Scholar, is a unique strength of this study. This study strengthens the conclusions of previous studies like (PLoS Medicine Editors, 2006; Rossner, Van Epps, & Hill, 2007; Seglen, 1997) and confirms that Thomson Reuters still continues their practice of manipulating citation data. Although the staff of Thomson Reuters claimed that impact factor was accurate and consistent “due to its concentration on a simple calculation based on data that are fully visible in the Web of Science” (McVeigh & Mann, 2009, p. 1109) but the findings of the previous as well as the present study disprove this statement. Discrepancies have also been found in the Scopus calculations. This study proves that the use of fake number of citations is a common practice in impact factor calculation based on illogical, unethical and unscientific practices. Editorial material is usually undervalued and considered as non-citable for use as a denominator in an equation. On the other hand, all citations on this material are counted in the numerator. A simple solution to avoid this discrepancy is to include them in all in research assessment procedures, as suggested by Van Leeuwen, Costas,Calero-Medina, and Visser (2013).

Issues like discretion, not publically known and non-replication of calculations must not be acceptable to stakeholders. Web of Science and Scopus have published their criteria for calculations and mentioned document types they use. What is citable and what is not citable is decided in research. Whatever is considered by WoS or Scopus as specified types of documents can be delimited from available search options on websites of both databases. Impact factors or impact per publication can be calculated by anybody. Therefore, the claimed impact factor system is transparent by itself but impact factor declarations are problematic and can be contested or claimed in a proper way wherever it is of serious concern.

Conclusion, Limitations, Implications and Recommendations for Future Research

This study has some theoretical and practical implications. On the theoretical side, it will stimulate further research regarding assessment, evaluation, and quality measurement of research. Likewise, this study may help in attracting attention of researchers to check their exploitation in the name of quality scores, high productivity, brand-oriented or franchised publications. It may also help to highlight the efforts for business promotion or industrialized thinking about research rather than the promotion of real knowledge and science for real development. Practically, this research may help librarians, policy makers, information analysts, bibliometricians, and researchers to find their way in contributing knowledge rather than being sucked into marketing and publicity scenarios designed by the corporate sector in the publishing industry. This study will stimulate further research to explore contradictions in policies and practices of prominent actors such as Thomson Group and Elsevier in this study. It is also suggested that this study should be replicated with a larger sets of journals in other subject areas.

Bibliometric indicators are of a high value for research and for the scientific contribution to knowledge. Reference and citation extended databases have an added value to the research process. Unfortunately, bibliometric indicators have been used as performative measures and evaluation tools by the administration of academia and research financing bodies over the last decade. The research community has been badly affected due to these misleading impact metrics. Publishing and productivity with high impacts have diverted attention of the researchers from contributing to knowledge. They have shifted their focus from knowledge to tactical productivity to cope and counter the unduly emerged awards, rewards, and promotion systems. An objective shift on the part of the researchers highly promoted publishing industry. The unavailability of appropriate quality measures for one’s performance and the value of research lend support the existing numeric impact system. To save oneself from the exploitation from numerical impacts, it is a challenge and a research task for scholars to come up with a justifiable, reliable, consistent and transparent system of performative evaluation of researchers, as well as qualitative value of one’s scientific contribution in a particular field, discipline, or research area.

In the present study, the number of citations and number of citable items/documents differ from the numbers presented by WoS as well as Scopus during manual calculations. It was not clear which articles, reviews, and conference papers were not included as citable items on both these citation databases. It was also unclear why other items or documents that the research community considered as citable items / documents were excluded in these databases. Both WoS and Scopus continuously include journals in their indexes. Therefore, inclusion of any new journal in WoS or Scopus system changes the data set and the results presented in this study. Furthermore, being the denominator, the number of citable items / documents was of much importance due to their considerable impact on the final results. Therefore, a general perception about articles, reviews, and conference papers was adopted in this research. The authors of this study used their subjective approach in concluding what amounted to a citable item or not. It is a limitation of this study. Another limitation of our study is that it was restricted to only three journals. For generalization of results more studies with larger sets of journals are needed.

REFERENCES

Bar-Ilan, J. (2010). Citations to the "Introduction to Informetrics" indexed by WOS, Scopus and Google Scholar. *Scientometrics, 82*(3), 495-506.

Bergman, E. M. (2012). Finding citations to social work literature: The relative benefits of using Web of Science, Scopus, or Google Scholar. *The Journal of Academic Librarianship, 38*(6), 370-379.

Binswanger, M. (2014). Excellence by nonsense: The competition for publications in modern science. In S. Bartling, & S. Friesike (Eds.), *Opening Science* (pp. 49-72). Springer International.

Blaise, C. (2014). Scholars and Scripts, Spoors and Scores. In C. Blaise, & C. R. Sugimoto (Eds.), *Beyond Bibliometrics: Harnessing multidimensional indicators of scholarly impact.* (pp. 3-21). MIT Press.

Brumback, R. A. (2008). Worshiping false idols: The impact factor dilemma. *Journal of Child Neurology, 23*(4), 365-367.

Brumback, R. A. (2009). Impact Factor: Let's be unreasonable! *Epidemiology, 20*(6), 932-933.

Campbell, P. (2008). Escape from the Impact Factor. *Ethics in Science and Environmental Politics, 8*(1), 5-6.

Carrió, I. (2008). Of impact, metrics and ethics. *European Journal of Nuclear Medicine and Molecular Imaging, 35*(6), 1049-1050.

Chew, M., Villanueva, E. V., & Van Der Weyden, M. B. (2007). Life and times of the Impact Factor: Retrospective analysis of trends for seven medical journals (1994-2005) and their editors' views. *Journal of the Royal Society of Medicine, 100*(3), 142-150.

Day, R. E. (2014). The data - It is me! In B. Cronin, & C. R. Sugimoto (Eds.), *Beyond bibliometrics: Harnessing multidimensional indicators of scholarly impact* (pp. 67-84). MIT Press.

De Bellis, N. (2014). History and evaluation of (biblio)metrics. In B. Cronin, & C. R. Sugimoto (Eds.), *Beyond Bibliometrics: Harnessing multidimensional indicators of scholarly impact* (pp. 23-44). MIT Press.

Dong, P., Loh, M., & Mondry, A. (2005). The "impact factor" revisited. *Biomedical Digital Libraries, 2*(7), 1-8.

Elsevier. (2015). *About Impact per Publication (IPP)*. Retrieved 08 23, 2015, from http://www.journalmetrics.com/ipp.php

Elsevier. (2015). *Compare journals*. Retrieved 08 23, 2015, from http://www-scopus-com.lib.costello.pub.hb.se/source/eval.url

Elsevier. (2015). *Journal Rankings*. Retrieved 08 23, 2015, from http://www.scimagojr.com/journalrank.php

Falagas, M. E., & Alexiou, V. G. (2008). The top-ten in Journal Impact Factor manipulation. *Archivum Immunologiae et Therapiae Experimentalis, 56*(4), 223-226.

Frandsen, T. F. (2008). On the ratio of citable versus non-citable items in economics journals. *Scientometrics, 74*(3), 439-451.

Garfield, E. (1964). Science Citation Index - A new dimension in indexing. *Science, 144*(3619), 649-954.

Glänzel, W., & Moed, H. F. (2002). Journal impact measures in bibliometric research. *Scientometrics, 53*(2), 171-193.

Golubic, R., Rudes, M., Kovacic, N., Marusic, M., & Marusic, A. (2008). Calculating Impact Factor: How bibliometrical classification of journal items affects the impact factor of large and small journals. *Science and Engineering Ethics, 14*(1), 41-49.

Harzing, A. W. (2007). Publish or perish. Retrieved 08 23, 2015, from http://www.harzing.com/pop.htm

Jasco, P. (2001). A deficiency in the alogritm for calculating the Impact Factor of scholarly journals: The Journal Impact Factor. *Cortex, 37*(4), 590-594.

Kumar, M. (2010). The import of the Impact Factor: Fallacies of citation-dependent scientometry. *Bulletin of the Royal College of Surgeons of England, 92*(1), 26-30.

Law, R. (2012). The usefulness of Impact Factors to tourism journals. *Annals of Tourism Research, 39*(3), 1722-1724.

Law, R., & Li, G. (2015). Accuracy of Impact Factors in tourism journals. *Annals of Tourism Research, 50*, 19-21.

Leydesdorff, L., & Opthof, T. (2010). Scopus's Source Normalized Impact Per Paper (SNIP) versus a Journal Impact Factor based on fractional counting of citations. *Journal of the American Society for Information Science and Technology, 61*(11), 2365-2369.

Martin, B. R. (2016). Editors' JIF-boosting stratagems-Which are appropriate and which not? *Research Policy, 45*(1), 1-7.

McVeigh, M. E., & Mann, S. J. (2009). The Journal Impact Factor denominator: Defining citable (counted) items. *JAMA, 302*(10), 1107-1109.

Merton, R. K. (1957). Priorities in scientific discovery: A chapter in the sociology of science. *American Sociological Review, 22*, 635-659.

Moed, H. F. (2005). *Citation Analysis in research evaluation* (Vol. 9). Springer Science and Business Media.

Moed, H. F., Van Leeuwen, T. N., & Reedijk, J. (1999). Towards appropriate indicators of journal impact. *Scientometrics, 46*(3), 575-589.

Monastersky, R. (2005). The 'number that's devouring science. *Chronicle of Higher Education, 52*(8), 14.

Nelhans, G. (2014). Qualitative scientometrics? *Proceedings of the 35th IATUL Conference.* The International Association of Scientific and Technological University Libraries (IATUL).

Rossner, M., Van Epps, H., & Hill, E. (2007). Show me the data. *The Journal of Cell Biology, 179*(6), 1091-1092.

Rousseau, R. (2012). Updating the Journal Impact Factor or total overhaul? *Scientometrics, 92*(2), 413-417.

Salton, G. (1963). Associative document retrieval technologies using bibliographic information. *Journal of the ACM (JACM), 10*(4), 440-457.

Seglen, P. O. (1997). Why the Impact Factor of journals should not be used for evaluating research. *BMJ, 314*(7079), 498-502.

Sevinc, A. (2004). Manipulating Impact Factor: An unethical issue or an editors's choice. *Swiss Medical Weekly, 134*(27-28), 410.

Simons, K. (2008). The misused Impact Factor. *Science, 322*(5899), 165-165.

Smart, P. (2015). Is the Impact Factor the only game in town? *The Annals of the Royal College of Surgeons of England, 97*(6), 405-408.

The PLoS Medicine Editors. (2006). The Impact Factor game. *PLoS Med*, 291.

Thomson Reuters. (1994, 06 20). *The Thomson Reuters Impact Factor*. Retrieved on 08 23, 2015, from http://wokinfo.com/essays/impact-factor/

Thomson Reuters. (2012). *Journal Citation Reports*. Retrieved 08 23, 2015, from http://admin-apps.webofknowledge.com/JCR/help/h_sourcedata.htm

Van Leeuwen, T. N., Moed, H. F., & Reedijk, J. (1999). Critical comments on Institute for Scientific Information Impact Factors: A sample of inorganic molecular chemistry journals. *Journal of Information Science, 25*(6), 489-498.

Van Leeuwen, T., Costas, R., Calero-Medina, C., & Visser, M. (2013). The role of editorial material in bibliometric research performance assessment. *Scientometrics, 95*(2), 817-828.

Whitehouse, G. H. (2001). Citation rates and Impact Factors: Should they matter? *The British Journal of Radiology, 74*(877), 1-3.

Wolthoff, A., Lee, Y., & Ghohestani, R. F. (2011). Comprehensive Citation Factor: A novel method in ranking medical journals. *European Journal of Dermatology, 21*(4), 495-500.

Wouters, P. (2014). The citation: From culture to infrastructure. In B. Cronin, & C. R. Sugimoto (Eds.), *Beyond bibliometrics: Harnessing multidimensional indicators of scholarly impact.* (pp. 47-66). MIT Press.

Wu, X. F., Fu, Q., & Rousseau, R. (2008). On indexing in the Web of Science and predicting Journal Impact Factor. *Journal of Zhejiang University SCIENCE B, 9*(7), 582-590.

Zupanc, G. K. (2014). Impact beyond the Impact Factor. *Journal of Comparative Physiology A, 200*(2), 113-116.