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Web-based citation[1]: a new metric for evaluating scientific journals

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Abstract:

Purpose: *For many years, the traditional citations indexes such as Web of Science and Scopus used to evaluate scientific journals. It is time to use new metric in library for evaluating scientific journals. This research tries to introduce web-based citation as a new metric for evaluating scientific journals, and answer the question of whether web-based citations could complement or even replace traditional citation or not.*
Methodology: *In order to answer this question overlapping of these two types of citations was examined. Traditional citations were extracted from Web of Science and Scopus and web-based citation were extracted from Google Scholar. For this purpose 1344 research articles from 98 scientific open access journals in medical sciences, technology and engineering, humanities and social sciences were selected by proportional sampling method. The methodology used in this study was citation analysis.*
Findings: *Results showed that the number of web-based citation (Google Scholar) in humanities, social sciences, technology and engineering and medical sciences were respectively 10, 9, near 5 and 2 more than the number of Web of Science. Overlapping citation showed that 74 percent of Web of Science citations and 70 percent of Scopus citations were covered by web-based citation in Google Scholar. Therefore, it can be concluded that the web-based citation could be used as new metric for evaluating scientific journals. The results showed web-based citations could complement or even replace traditional citations. It is time for libraries to take action and include support for web-based citation as well as traditional citation metrics in the selection and collection of scientific journals.*

Keywords: Web-based citation, Traditional citation ,Web of Science, Scopus, Google Scholar, Scientific journal.

[1] AUTONOMOUS CITATION INDEXING ON THE WEB (SUCH AS GOOGLE SCHOLAR)

Introduction

Historically, citation phenomenon is as old as writing (Horri, 2002). Garfield considered citation as a mental and cultural process and believes that, citation is not just a list of data extracted from the citation index, but it expresses the intertextuality[2] relationship in citing and cited works(Neshat, 2011). Citation index communicates between previously written books and articles, and the articles that refer to them. Through citation indexes, the qualitative and quantitative evaluation of the scientific studies can be achieved.

Tracking citations is one of the oldest and most common methods of evaluating scientific journals. For years, traditional citation databases (such as Web of Science and Scopus) are detected citations and journals are evaluated in this way. Before the advent of the web, only the bibliometrics method was used to measure the impact of citations (Kousha, 2007a, p .213). On the other hand, the advent of the web and the increasing dissemination of scientific and research works in this environment has created a wide range of web-based citations which are traceable in the web environment.

Now, it is time to use new metric in library for evaluating scientific journals. This research tries to introduce web-based citation as a new metric for evaluating scientific journals, and provide an answer to the question of whether web-based citations could complement or even replace traditional citation or not. In order to answer this question overlapping of these two types of citations were examined. Traditional citations were extracted from Web of Science and Scopus and web-based citation were extracted from Google Scholar.

Method used in the web environment is very similar to citation analysis. In citation analysis, the number of citing scientific papers by other scientific papers (ie included in the reference list), is presented as a sign of the impact of research.

On the other hand, for the invention and development of the web, the full text of articles published in scientific journals was gradually available to researchers, in electronic format and open access publishing platform. That means the web has become a major channel for scientific communication among researchers. In fact, the internet and the web, have revolutionized the traditional system of scholarly communication, the production and distribution of information, and have led the pattern of access to scientific sources and research findings from the subscription-based to a system of open access based platforms (Norouzi, 2006, p. 15).

In recent years, open access journals were quickly joined into scholarly communication and have become a form of publication for scientific literature. Now, an important percent of scientific texts are published only in the form of open access journals. The increase in number of open access journals reflects the rapid developments in publishing model, (Kousha and Thelwall, 2006) and nearly the end of circle of traditional scholarly journals has been predicted to happen soon (Harnard, 1999). The amount of citations in scientific papers significantly depends on their visibility and accessibility. Publishing method of open access journals can play an effective role in increasing the research impact of papers (Noruzi, 2006). Hence, the study of open access journals and their citation impact can be very important. This has led the researcher to use open access journals as the research community.

Methodology

[2] .Intertextuality is the shaping of a text's meaning by another text. Intertextual figures include: allusion, quotation, calque, plagiarism, translation, *pastiche* and parody. Intertextuality is a literary device that creates an 'interrelationship between texts' and generates related understanding in separate works.

In this research, open access journals articles in 2014 with regard to articles have three-year opportunity for citation[3] on the DOAJ[4] website in four main area of universities: medical, engineering, social sciences and human sciences selected (DOAJ ,2017). Different areas were selected because each area has its own citation pattern, as in any field, different sources of information are searched by researchers. Selection of main universities areas, which have subfields, may be a more appropriate approach for the selection of disciplines, and perhaps the results can be cautiously extended to a wider range of disciplines associated with them. Since the selection of all areas led to population expansion, and since, the data must be collected in a short time, because the time has an impact on the validity and reliability of data, areas were selected that were more common. In each area two disciplines were selected randomly. Then select all journal of disciplines and research papers were extracted.

To determine the study population in any discipline, first the titles of research articles (3151 articles) in the selected journals (98 journal) were determined that indicate the total the study population in each discipline, then sample size was calculated based on the total number of the study population with confidence interval of 95% and the margin of error of 5, was calculated through sampling special software[5]. After determining the sample size (1344 articles) in each of the eight disciplines under study, the random stratified sampling method was used to select journal articles, which is based on sequential numbering of journal articles, and then selection of random numbers table-based articles.

Table 1-The number of articles under study and the sample size in each discipline

Area	Discipline	The number of journals	The number of research articles	Sample
Humanities	Linguistics	10	100	80
	philosophy	11	196	131
Social Sciences	Library and information science	14	325	177
	Sociology	9	92	75
Engineering	Urban Engineering	8	398	196
	Computer Science	23	830	263
Medical	Surgery	10	230	145
	Oncology	13	980	277
Total		98	3151	1344

For data collection, the title of 1344 research paper were searched separately by Web of Science, Scopus and Google Scholar. Traditional citations were extracted from Web of Science and Scopus and web-based citation were extracted from Google Scholar.

[3]. Investigation conducted announced that 3 or 4 years is enough to track citations. Of course, more studies have considered 3 years such as this study.

[4] . https://doaj.org/

[5]. http://www.raosoft.com/samplesize.html

Finding

Table 2 was prepared in response to the question, "What is the number of traditional and Web-based citations indexed database to scientific journals"?

Table 2: Frequency distribution and statistical indicators of traditional and Web-based citations indexed databases to scientific journal

Area	Journal	Web of Science				Google Scholar				Scopus			
		Number	Average	SD	Middle	Number	Average	SD	Middle	Number	Average	SD	Middle
Humanities	Linguistics	26	1.73	1.49	1	214	3.29	5.07	2	0	-	-	-
	Philosophy	1	-	-	-	59	1.23	2.01	0	0	-	-	-
Social Sciences	Library	53	1.89	1.72	1	503	3.18	4.73	1	177	2.23	3.36	1
	Sociology	14	1.56	0.73	1	90	1.84	1.84	1	20	2	5.1	1.5
Engineering	Urban engineering	252	2.45	4.05	1	283	1.67	3.78	0	255	3.36	5.2	2
	Computer	168	1.98	3.43	1	1738	7.27	13.2	3	716	4.11	7.01	2
Medical	Surgery	109	2.53	2.75	2	345	2.4	3.52	1	199	2.49	3.16	2
	Oncology	1689	6.72	6.49	5	2858	10.55	10.46	8	2259	8.37	8.34	6
Total		2312	2.36	-	-	6090	3.88	-	-	3626	2.83	-	-

Table 2 shows that the highest citation is dedicated to oncology journals and lowest citation to philosophy and linguistics journals. Oncology journals have accounted the highest average citation and philosophy journals have accounted the lowest average citation among all three citation databases. The highest standard deviation in all three citation databases is related to computer science journals and lowest standard deviation is related sociology journals. What is evident in this table, there are more Google Scholar web-based citations than Web of Science and Scopus traditional databases.

To answer this question, "Does Google Scholar web-based citations can be used as a metric for evaluating scientific journals? It is necessary to examine the overlapping Google Scholar web-based citations and Web of Science and Scopus traditional citations. If overlapping these two databases with Google Scholar is at a high level, it can be concluded that web-based citations can be used as an alternative to traditional citations for evaluating scientific journals.

Table 3: The overlap between the citations in Web of Science, Scopus and Google Scholar databases.

Area	Journal	Number of Article	Citation count			Overlapping citations		
			Google Scholar	Scopus	Web of Science	Google Scholar & Scopus	Google Scholar & Web of Science	Web of Science & Scopus
Humanities	Linguistics	80	214	0	26	0	14	0
	Philosophy	131	59	0	1	0	1	0
Social Sciences	Library	177	503	177	53	93	17	29
	Sociology	75	90	20	14	11	5	0
Engineering	Urban engineering	196	283	255	252	101	122	200
	Computer	263	1738	716	168	524	129	140
Medical	Surgery	145	345	199	109	137	76	66
	Oncology	277	2858	2259	1689	1694	1349	1521
Total		1344	6090	3626	2312	2560	1713	1956

Table 3 shows the amount of overlap between the citations in Web of Science, Scopus and Google Scholar databases. Since, linguistics journals in Scopus have received no citation, therefore, the possibility of overlap with the Google Scholar database was not provided. Philosophy journals also have received no citation in the Scopus database, and on the other hand, in the Web of Science database, only one citation has been reported which is not acceptable for statistical analysis, so in philosophy, the possibility of examination of overlap these two databases with Google Scholar was not provided.

The highest amount of overlap between the Scopus and Google Scholar databases with 1694 common citations is dedicated to oncology journals. In these journals, common citations between Web of Science and Google Scholar with 1349 citations and between Scopus and Web of Science, with 1521 citations in comparison with other studied journals are in the first place. In addition, all areas and journals show the highest overlap between Scopus and Google Scholar with 2560 common citations.

But to answer the exact amount of overlap, the percentage of overlap, the percentage of unique citations must be calculated. Therefore, in two next tables, the percentage of overlap, the percentage of unique citations in all three databases was presented for each discipline.

Table 4: the percentage of overlap and unique citations in the Web of Science and Google Scholar databases

Area	Journal	Number of paper	Citation count		Overlapping citations between Google Scholar & Web of Science	Relative Overlap		Unique Citations	
			Google Scholar	Web of Science		Google Scholar	Web of Science	Google Scholar	Web of Science
Humanities	Linguistics	80	214	26	14	6.54	53.85	93.46	46.15
Social Sciences	Library	177	503	53	17	3.38	32.08	96.62	67.92
	Sociology	75	90	14	5	5.56	35.71	94.44	64.29
Engineering	Urban engineering	196	283	252	122	43.1	48.41	56.9	51.59
	Computer	263	1738	168	129	7.42	76.79	92.58	23.21
Medical	Surgery	145	345	109	76	22.03	69.72	77.97	30.28
	Oncology	277	2858	1689	1349	47.20	79.87	52.80	20.13
Total		1213	6031	2311	1712	28.39	74.08	71.61	25.92

Table 4 shows that the percentage of overlap and unique citations in Google Scholar web-based database, and Web of Science traditional database. Of course, since the number of citations in Web of Science in philosophy journals was only one case, and it is unacceptable for statistical analysis, so in the humanities, the only overlap of Linguistics journals was studied. The results of a comparative study between the 6031 Google Scholar web-based citations manually with 2311 Web of Science traditional showed that there are 1712 common citations in these two databases. The highest overlap percentage is related to oncology journals in Web of Science with 79.87 percent. In Google Scholar database, the highest overlap is accounted to this discipline with 47.20 percent. The highest unique citations related to Library and information science journals with 96.62% in Google Scholar database. The highest percentage of unique citations in Web of Science is also related to the Library and information science with 67.92 percent. This could indicate that the library and information science journals in both databases have provided good coverage, but the amount of overlap in this discipline is at the lowest level table.

In general, in all studied journals in table 4, the overlap of Web of Science with Google Scholar is 74.08. The highest unique citation is allocated to Google Scholar database with 71.61 percent.

Table 5: the percentage of overlap and unique citations in the Scopus and Google Scholar databases

Area	Journal	Number of Paper	Citation Count		Overlapping citations between Google Scholar & Scopus	Relative Overlap		Unique Citations	
			Google Scholar	Scopus		Google Scholar	Scopus	Google Scholar	Scopus
Social Sciences	Library	177	503	177	93	18.49	52.54	81.51	47.46
	Sociology	75	90	20	11	12.22	55	87.78	45
Engineering	Urban engineering	196	283	255	101	35.69	39.61	64.31	60.39
	Computer	263	1738	716	524	30.15	73.18	69.85	26.82
Medical	Surgery	145	345	199	137	39.71	68.84	60.29	31.16
	Oncology	277	2858	2259	1694	59.27	74.99	40.73	25.01
Total		1133	5817	3626	2560	44	70.6	66	29.4

Table 5 shows the percentage of overlap and unique citations in the Scopus and Google Scholar. Since there is no citation in the humanities (linguistics and philosophy) in the Scopus database, in this table, overlap only in three areas of social sciences, engineering and medicine were studied. The results of a comparative study between the number of 5817 Google Scholar web-based citations manually with 3626 Scopus traditional citations showed that, in the two databases, there are 2560 common citations. The highest percentage of overlap is dedicated to the oncology journals in Scopus database with 74.99 percent. In Google Scholar database, the same discipline with 59.27 percent has the highest level of overlap. In the Google Scholar database, the highest individual citations is related to sociology journals with 87.78 percent and in Scopus database, the highest individual citations belongs to the journal of urban engineering with 60.39 percent.

Generally, in all 6 studied disciplines, Scopus database overlap with Google Scholar is 70.6 percent. In other words, nearly two-thirds of the citations in the Scopus database are available in free of charge and accessible Google Scholar database. The unique citations of Google Scholar database is 66 percent which compared with the unique citations in Scopus database with 29.4 percent shows twice increase indicating the comprehensiveness of this database compared with Scopus.

Conclusion

The findings of this study showed that the number and average traditional citations in Web of science and Scopus citation database is far lower than the number and the of web-based citations in Google Scholar database suggesting a significant increase in web-based citations compared to the traditional citations. This issue earlier have been introduced in previous research which

is consistent with the results of the present study (vaghan and Shaw, 2005; Bauer and Bakkalbasi, 2005; Kousha and Thelwall, 2007; Clarka and Gila, 2009) and this study confirmed the results of previous research. It can be deduced that, web-based citations database compared to the traditional database citations better acts in tracking citations. However, this point should not be overlooked that the quality of web-based citations is unclear, and the quality of these citations isn't evaluated, but the quality of what is offered in traditional citation database, has been verified by experts.

Investigation of the citations showed that in journals in various areas, the humanities in this study (linguistics and philosophy) did not provide adequate coverage in traditional citations. It seems that these citation databases are weak in tracking citations in the area of humanities. But reviewing the humanities citations in Google Scholar web-based citation database, which was created with the aim of counting and tracking of citations, provided the more comprehensive coverage, and can be understood that, web-based citations to track and impact the humanities citations are much more favorable than traditional citations. In summary, It can be concluded that, in the area of humanities in which journals are not considered the most important scientific communication channel, Web of Science and Scopus can't have the required efficiency. On the other hand, Google Scholar citations to articles in humanities journals are at a level which, it can be used as a citation database and a bibliometrics tool for tracking citations in this area. The data showed that the rate of Google Scholar web-based citations in humanities is almost ten times the total citations in Web of Science and Scopus, and indicate that, traditional citations in humanities have done poorly, and Web-based citations have higher efficiency in this area.

In the area of social sciences, Google Scholar web-based citations are more than 2 times the total citations in Scopus and Web of Science. The statistics show that, in the social sciences, the Google scholar web-based database has acted better and has had more comprehensive. It can be concluded that, Web-based citation provides a better metric in the areas of humanities and social sciences compared to metric of traditional citation database for evaluating scientific journals.

The data showed that the overlap between Web of Science and Google Scholar in the discipline of oncology is close to 80%; in other words, 80 percent of citations in Web of Science in the discipline of oncology are covered in Google Scholar. Bakkalbasi, et al. (2006) in a research have reported almost the same results for the discipline of oncology, and this study confirmed their results. Therefore, it can be concluded that, in the absence of the Web of Science, Google Scholar database can be selected in this particular discipline as an alternative to track citations, and to purchase and subscribe the journals.

In contrast, in the discipline of Library and Information Science, because of overlapping Google Scholar and Web of Science databases is very low, and on the other hand, the percentage of unique citations is high for both, so using data from Google Scholar to replace Web of Science citations in this discipline can't not justified, but also the data can be used as complementary data for Web of Science in Library and information Science, and to subscribe journals in the discipline. Google Scholar Web-based data can be used as Web of Science supplemental data in this discipline.

Overall, in seven disciplines studied in terms of overlap in Web of Science and Google Scholar, about two-thirds of Web of Science citations are covered in Google Scholar. In several studies, overlap between the two databases has been very high (Bauer and Bakkalbasi ,2005 ; Kousha, 2007b; Kousha and Thelwall and Rezai, 2010). Therefore, in case of lack of access to Web of

Science, and given the high cost of access to the database, Google Scholar data can be used with high confidence for evaluating journals, because this database provides proper coverage of the Web of Science database. On the other hand, the high percentage of Google Scholar unique citations (71%) may indicate comprehensive of the database, which can be a metric for selection of scientific journals. Expanded coverage and the comprehensiveness of this database has always been emphasized by many research (Bauer and Bakkalbasi, 2005; Bakkalbasi, et al. 2006; Abdoli and Kousha, 2007, Kulkarni, et al. 2009; Jaćimović, Petrović and Živković, 2010; Šembe, Utrobičić and Petrak, 2010; Kousha, Thelwall and Rezai, 2010).

Study of overlapping Scopus traditional database, and Web-based Google Scholar database indicates that almost two-thirds of the citations of oncology in the Scopus database are also available in the Google Scholar database. So in the absence of Scopus database in the discipline of oncology, data from Google Scholar can be largely used as an alternative to select and subscribe of medical journals.

In 6 studied disciplines, 70% of the existing citations in the Scopus database are available in Google Scholar database. Bosman, et al. (2006) have reported that overlapping of these two databases are high, which this study confirmed it. So it can be concluded that, given the cost of the database, especially for developing countries, it seems that the use of Google Scholar database is not only affordable, but it covers a very large volume of Scopus data. Reviewing unique citations in the two databases showed that the rate of unique citations in Google Scholar is double the rate of unique citations in Scopus, which can indicate a broader and more comprehensive coverage of the Web-based citation database.

The data showed that, in total, covering Web of Science database is significantly lower than Scopus and Google Scholar databases. So it appears that to select and purchase scientific journals, especially in the area of medicine, assessment and criteria of Scopus database and the number of Scholar Google web-based citations is more favorable than Web of Science database. This can be considered in the subscribe of scientific journals in the medical field.

In general, based on the results of this study, it can be deduced that, web-based citations compared to the traditional citations are more comprehensive and since that the overlap Google Scholar with Web of Science is 74%, and overlap of 70 percent has been reported with Scopus, therefore, Google Scholar citation data is reliable, and can be used as a new tool for evaluating scientific journals and as a metric for subscribe scientific journal in libraries.

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