Altmetric and Bibliometric Scores: Does Open Access Matter?

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Abstract: Since new publishing models and new communication channels are being developed, traditional ways of measuring journal and article impact are not sufficient – besides bibliometrics, altmetrics arises as a new method based on quantitative analysis of mentions on blogs, in the news, shares on social networking sites etc. The main purpose of the study is to analyze the altmetric indicators for Altmetric top 100 articles in 2014, and to compare them with traditional bibliometric data for the same articles. Also, altmetric scores for Open Access (OA) articles are compared to the scores for non-OA articles. The research confirms low correlation between the number of citations (in the first year after publication) and the altmetric score. Nevertheless, the altmetric score has a potential role in promoting articles and getting post-publication evaluation and feedback.

Keywords: altmetrics, bibliometrics, citation advantage, Open Access, social networking sites

1. Introduction

Today more and more scientists read, share and discuss issues using "non-traditional" ways of scholarly communication which promote open access (OA) and open science. Social networks are creating new ways for communication in academic community, using many advantages of Web 2.0. The flow of information and knowledge is higher and faster – to be able to track and even spot the research development, is necessary to focus on both formal communication (through publishing articles, books, etc.) and informal communication (through social web).

Scholars and students increasingly use social networking tools, such as Twitter, Facebook or Mendeley, as means of scientific communication. New information and communication technologies expand a potential customer base and increase the availability of scholarly information through the Internet (Lally, 2001). On the other side, the same technologies provide platforms for publishing enormous

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amount of unevaluated information. Therefore, evaluation is essential for scholarly information. Quality can be controlled through peer-review process (traditionally before publishing, but new, post-publication models are also applicable) and through bibliometric and, lately, altmetric methods. Although OA citation advantage has already been proved, the new questions arise – is there OA altmetrics advantage; are OA articles more likely to be shared on Web 2.0 services; and is altmetrics a good way to evaluate scholarly information?

2. Literature Review

As van Raan (1996) says, the fundamental purpose of evaluation is ensuring research quality – therefore evaluation is a necessity.

Bibliometrics, as a traditional method of quantitative analysis of academic literature quality is no longer sufficient to calculate the impact of a scientist and his work because bibliometrics does not include informal communication.

Online tracking tools are moving beyond traditional citation-based performance analysis into new citation databases that attempt to cover a larger variety of the researcher's output, the impact of scholarly communication in social networks and public services. According to Priem et al. (2010), altmetrics is "the creation and study of new metrics based on the social web for analyzing and, informing scholarship." Altmetrics includes data about usage (e. g. pdf downloads); captures (e. g. Bookmarks); mentions (e. g. in Blogs); social media (e. g. shares on Facebook) and citations (e. g. Scopus) (Cave, 2012). Altmetrics is proposed as an alternative to (and the extension of) the traditional bibliometric indicators (such as Journal Impact Factor or h-index). Altmetric studies can include not only quantitative but also qualitative assessments, which describe diversity, speed, openness and informality studies (Cronin and Sugimot, 2014).

Traditional metrics, based only on counting citations, cannot keep track of the variety of online activities. Alternative indicators, on the other side, offer different view of the impact of a particular paper and/or author.

Citation is taken as an indicator of visibility, influence and thus relevance of the cited work. Citation impact indicators are indicators of scholarly impact that are based on an analysis of the citations received by scientific publications (Craig, et al., 2007.). Citation impact indicators nowadays play a prominent role in the evaluation of scholarly research. It takes time to accumulate citations – depending on the discipline, sometimes it takes years after publication to get impact of the paper that can be measured. One of the ways to measure impact right after publication is calculation of impact factors (IF), but the relationship between citation and the IF is weakening (Lozano, Larivière and Gingrass, 2012). Therefore, impact of publication on social media may be seen as a predictor, or a supplement to IF and similar traditional indicators.

There are several tools developed to gather altmetrics, e. g. PLOS Article-Level Metrics, CitedIn, altmetric.com and ScienceCard (Priem, Piwowar and Hemminger, 2012). Altmetric indicators should be taken with caution because the whole field is new, it changes, and many researches are still to be done in order to define, determine and develop the field of altmetrics. Nevertheless, altmetric indicators can help in identifying topics that are interesting to scientists

and wider public (Crotty, 2014). Each of the altmetric services has its own criteria and algorithm to calculate the impact of social networks and interactions, but they do not distinguish between positive and negative comments (the same as in traditional method of counting citations – some citations are positive and some are negative).

Previous studies indicate that there is a clear correlation between the number of times an article is cited and its freely online availability (Lawrence, 2001; Harnad and Brody, 2004; Kurtz et al., 2005; Gargouri et al., 2010; Davis and Walters, 2011). There are still very few studies about connection between OA and altmetric scores. First of all, it is important not to apply the same criteria for older and as for newer articles. Web 2.0 is developing, e. g. there are more and more Twitter users every day. Therefore, the number of tweets for a 2009 article will be lower than for a 2015 article, maybe not because of the difference in quality, but because of the developing communication channels. Also, altmetric scores can depend on scientific field – e. g. people tweet life sciences papers more than some other papers (Adie, 2014).

Mounce (2013) indicates that there could be OA altmetric advantage because of better visibility – 7 out of top 10 papers measured by altmetric.com in 2012 were OA papers. The author also recalls that OA model is relatively established, but altmetrics is still new and unexplored.

Bernal (2013) summarizes some researches about OA and new metric methods saying that altmetrics is added value for OA (Konkier and Sherer, 2013) and that there is a correlation between page views with citations and impact on social media (Priem, Piwowar and Hemminger, 2012).

3. Sample and Methodology

The main purpose of this study is to compare altmetric indicators for the Altmetric (2014) top 100 articles with traditional bibliometric indicators, and to find if there is a correlation between altmetric scores and OA. OA means that articles are freely available online. Altmetric is focused on social platform that often provides free access to usage data through Web APIs, so data is easy to collect (Cronin and Sugimoto, 2014). Altmetric.com published a list of top 100 articles with the best altmetric scores at the end of 2014. The list contains OA and non-OA articles from different fields of science. The 2014 altmetric indicators for all the 100 articles are compared to the number of citations in Scopus, Web of Science Core Collection and Google Scholar (in January 2016). OA citation advantage has been already proved in earlier researches, and our intention was to find out if there is also an OA altmetric advantage, i. e. if OA articles have higher altmetric scores.

Therefore, our hypotheses are as follows:

i. OA articles have higher altmetric scores than non-OA articles
ii. articles with higher altmetrics scores also have more citations within the first year or two after publication.

Altmetric score on Altmetric.com includes number of shares or posts in news, on blogs, Wikipedia, Twitter, Facebook, Google+, Reddit and similar services, but do not include article level metrics, i. e. number of downloads or views (Glänzel and Gorraiz, 2015). According to Thelwall et al. (2013), and Costas, Zahedi, and Wouters (2014a), altmetric and webometric studies have tended to correlate citations with the web metric on the assumption that since citation counts are a recognized indicator of academic impact, any other measure that correlates positively with them is also likely to associate with academic impact. The goal of the research design was to devise whether higher altmetrics values associated with articles published in journals with higher impact factors.

4. Results

The articles from Altmetric.com list can be searched using five filters: journal title (36 titles), institution, subject category, country, access type (OA or paywall). The articles are divided into 12 subject categories. The authors of the top 100 articles come from 39 countries, and from 344 different institutions. Considering the time span in which the articles were published, 51 articles from the list were published between October 2013 and the end of April 2014. The other 49 articles were published from the beginning of May 2014 to the end of November 2014.

The number one ranked article on the list has an altmetric score of 5044, while the last article has the lowest altmetric score – 746. Average altmetric score is 1239.4 and the median is 952.2. The majority of the articles were published in Nature (16), Science (11), PloS ONE (9), PNAS (8), JAMA (4) etc. (Table 1.).

Relationship between the number of citations and altmetrics can be shown by an example of an article that has the highest citation count in all the three databases (WoS Core Collection 411, Scopus 475, Google Scholar 1086), published in a journal (JAMA) with high IF (30.387), and available on the journal's web site, but not in OA. The article is ranked 84th and has an altmetric score of 788.

Table 1 shows the list of all of the articles published in different journals according to traditional bibliometrics IF journals range which counts as part of the traditional bibliometrics. The biggest versatility in selecting a journal for publication and the number of published articles can be seen in the category with the highest IF span. The article published in the journal with the lowest IF (0.883) holds a high rank of 18 according to its altmetric score (1692).

Comparing and evaluating journals using citation data from ISI Web of Knowledge Journal Citation Reports (JCR) Science Edition, 89% of the Altmetric.com top 100 journals are placed (thematically indexed) only in one subject category (field), and the majority of the journals (76%) are among JCR highest quartile score (Q1), one journal is among middle-high JCR quartile score (Q2) and one is among middle-low JCR quartile score (Q3). In the JCR Social Science Edition only two journals that belong to the subject categories of Psychology and Multidisciplinary are in Q1. Furthermore, only 11% of the journals, in which the 100 analysed articles were published, cover more than one subject category (three journals are placed in a total of three categories, the rest of the journals are placed in two categories). Only 8 out of 100 articles were

published in journals not indexed in ISI Web of Knowledge JCR, and thus do not have an IF or quartile rank.

Table 1: Representation of all articles in different journals according to journal IF range

IF range	Journal title (no. of articles)
39.000-54.999	Lancet (2); Nature (16); New Engl J Med (9)
30.000-31.999	JAMA (4); Science (11) ; Cell (2)
28.000-28.999	Nature Med (1); Nature Methods (1)
16.000-19.999	Ann Intern Med (1); BMJ (3); Cell Metabol (1); Lancet Inf Dis (1)
14.000-14.999	PLOS Med (1); Nat Neurosci (4)
9.000-9.999	PNAS (8); Curr Biology (1)
6.000-8.999	J Neuroscience (1); Neurology (2)
5.000-5.999	Env Sci Technol (1); Scientific Rep (1)
4.000-4.999	Psychological Sci (2); Br J Cancer (1); Am J Pub Health (1)
3.000-3.999	PLOS ONE (9); Vaccine (1)
2.000-2.999	Frontiers in Zoology (1); Computers in Human Behaviour (1)
1.000-1.999	Ann Trop Med Parasit (1); Ethology (1); Personality & Individual Differences (1)
<1	J Profess Nurs (1)
n/a	arXiv (5); Translation Neurodegeneration (1); JAMA Intern Med (1); Science China (1); SSRN (1)

Thirty six out of top 100 articles were published in OA and 64 were published under the paywall/subscription model (although some will have been made free later on). Seven out of the top 10 articles with the highest altmetric score are in OA, including the article with the best altmetric score (5044).

Table 2 shows the first 20 OA articles analysed using traditional bibliometric methods (IF, Q). Considering the large amount of data related to each article, it was not possible to show all of them. The details can be found on Altmetric.com. The number of citations for each article (in January 2016) are shown separately for each database. For each article there are two subject

categories, one is from Altmetric.com, and the other is from WoS JCR. It is important to be aware of the differences in scholarly communication in different scientific fields (hence, bibliometric indicators for journals from different disciplines are not comparable). In table 1 and 2 "n/a" means not applicable to (those journals or repositories have not been indexed in WoS JCR.

Table 2: Twenty OA articles from the top 100 list with the best altmetric scores

Altmetric score / altmetric rank	**Journal/ *CC**	**Web of Science**				**Scopus**	**Google Scholar**
		JCR – ISI Web of Knowledge			**WoS Core Collect.**		
		IF	**Q**	**JCR -Subject category**			
5044/1	PNAS *	9.809	Q1	Multidisc. Sci	85	105	344
2956/5	Front. in Zoology *	2.304	Q1	Zoology	6	6	15
2734/6	BMJ*	16.378	Q1	Med Gener & Interal	2	5	15
2392/7	arXiv	n/a	n/a	n/a	n/a	n/a	36
2246/8	arXiv	n/a	n/a	n/a	n/a	n/a	4
2160/9	PLOS ONE	3.534	Q1	Multidisc. Sci	12	15	27
2146/10	BMJ	16.378	Q1	Med Gener & Interal	n/a	n/a	7
1694/15	PLOS ONE	3.534	Q1	Multidisc. Sci	2	5	7
1693/16	arXiv	n/a	n/a	n/a	0	n/a	108
1479/20	PNAS *	9.809	Q1	Multidisc. Sci	27	26	92
1423/23	BMJ*	16.378	Q1	Med Gener & Interal	21	25	46

1249/29	PNAS *	9.809	Q1	Multidisc. Sci	7	7	13
1138/34	arXiv	n/a	n/a	n/a	n/a	n/a	3
1120/35	Scientif. Reports	5.078	Q1	Multidisc. Sci	1	2	4
1074/37	Cell*	33.116	Q1/Q1	Biochem & Mol Biol/Cell Biol	33	35	60
1068/38	PLOS ONE	3.534	Q1	Multidisc. Sci	8	4	18
1060/39	Environ. Science & Techno.	5.481	Q1/Q1	Engin Environm. / Environm. Sci	1	3	7
957/50	PLOS Medic.*	14.0	Q1	Med Gener & Interal	34	47	97
935/53	Cell Metab.*	16.747	Q1 / Q1	Cell Biol/ Endocrin & Metabolism	68	70	107

If we analyse all the top 100 articles, it is obvious that OA and non-OA articles have similar results – average altmetric score is slightly higher for OA articles, but the median is slightly higher for non-OA articles (Table 3).

Table 3: Statistical average of articles regarding OA/non-OA

Function	**non-OA**	**OA**
average	1180.406	1344.139
min	751	746
max	4823	5044
median	957.5	946
No.	64	36

5. Conclusions

Most of the articles from the top 100 list come from the field of Medicine, the total of 44%. This may be because medicine is a specific field of science whose development depends on a rapid flow of information, causing a larger production of articles with many citations (Costas, Zahedi and Wouters, 2014b).

By reviewing the articles' titles one can conclude that articles from the field of Nutritional studies (about various diets) got the most attention, as well as articles with catchy titles (e. g. "Were James Bond's drinks shaken because of alcohol induced tremor?" or "Trolls just want to have fun"). These are the arguments against the value of altmetrics showing how altmetric score can be manipulated – there is a possibility that certain articles have high altmetric score because of the catchy title, or attractive subject (nutrition). Furthermore, 2 articles from top 20 were retracted – there is a possibility that they are "popular" because of the retraction, not because of their significance. The 2nd highest ranked article is popular because of the mistake authors and editors made (they forgot to delete the note to themselves about whether to cite "the crappy Gabor paper"). This fact is very interesting, especially because the two retracted articles are published in Nature (high IF journal), and they have lots of citations in the observed databases (these indicators should, at least at first sight, indicate the 'higher quality' of those articles).

The difference between journal-level metrics (journal IF) and article-level metrics (either traditional or altmetrics) is obvious – although considerable number of articles was published in journals with high IF (40% of articles in IF range 31.000-54.420), these articles do not have higher altmetric scores.

It is clear from Table 1 that most of the articles (16%) were published in Nature, 11% were published in Science, and 9 articles were published in the New Engl J Med and PLOS ONE respectively. These journals have a tradition of being "scientific trend-setters". Nature includes an altmetric score for each of its articles on their website – which is a way of raising awareness about the importance of altmetrics – and, therefore, it is not unusual that their articles made the list. The question is whether the altmetric score can be taken as an indicator of the quality of the research or is it just showing us the trends.

Overall, it is clear that a higher proportion of OA articles are more likely to get shared and discussed than those that are published behind a paywall, but that do not have an impact on their citation count.

The first hypothesis (OA articles have higher altmetric scores than non-OA articles) is not completely proven for the sample. There are more OA than non-OA articles in the top 10 articles (7 out of 10), but the overall proportion is on the side of non-OA articles (64 out of 100 are non-OA articles). By comparing altmetric scores and number of citations it is shown that there is no difference whether an article was published in OA or not.

Regarding the second hypothesis, there is not enough data to prove it either. There are some articles with high altmetric scores and relatively small number of citations (e. g. article ranked as the 2nd on the list has a very high altmetric score – 4832, and has 2 citations in WoS, 1 in Scopus and 3 in Google Scholar). Altmetric score is almost always higher than number of citations. There is only one article on the analysed list whose number of citation is higher than its altmetric score (altmetric score is 788, and it has 933 citations in WoS, 1073 in Scopus and 2131 in Google Scholar). The results have to be interpreted having in mind that all the sample articles have high altmetric scores. Further researches should include articles with law altmetric scores.

The findings suggest that the usage of altmetrics has a high potential for informing researchers, but still needs to be considered with caution. The questions remain: What do metrics based on social media impact tell us? Can the altmetric score be taken as an indicator of the quality of a research or does it just reflect the trend?

In general - OA articles are read more widely and generate higher citations than non-OA articles. However, on our sample the altmetric advantage of OA articles is not proven, but neither was the disadvantage. This research is just a small study conducted on a small sample and we consider it as an insight into a brand new field of altmetrics. The field is still developing and it will take years before conclusions about OA altmetric advantage or connection between bibliometric and altmetric scores could be drawn. There are many reasons for high altmetric scores, other than OA or journal IF (e. g. provocative titles or retracted articles). Scholars discuss scholarly articles on social networking sites and similar services, but those discussions do not always have the same significance as traditional citations.

Combining traditional and non-traditional metrics can give us a better insight into what kind of an impact an article has. When applying new methods, we have to follow trends, as they are constantly changing, and thereby influencing scholarly communication.

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