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The meaning of altmetrics

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Abstract

A range of quantitative methods are today widely used in research evaluation (e.g. Moed et al., 1985; Moed et al., 1995). Recently, with the increasing popularity of social media, and especially the increasing use of social media in scholarly activities, a new field of research has been introduced, namely altmetrics, to investigate the use of social media in research evaluation (Priem & Hemminger, 2010). Although altmetrics does not yet have a widely accepted definition, the idea with altmetrics is that the mentions and other indicators of visibility and awareness a research article and other research products get in social media could tell something about the impact or influence of that research. Earlier altmetric research have in fact found some indications that the social media visibility of a scientific article correlates with more traditional measures of research impact, such as citations, hinting at the value of altmetrics as a rapid source of data about research impact and its potential as a tool for research evaluation (e.g. Bar-Ilan et al., 2012; Mohammadi & Thelwall, 2013; Thelwall et al., 2013a). However, little research has focused on the underlying meaning and actual validity of altmetrics. Are altmetrics measures of impact of research and, if not, what do they measure? How is attention in social media created? Does visibility in social media mean the same thing as citation impact? This paper will review some of the earlier research on the topic and based on the earlier findings discuss challenges with altmetrics and the underlying meaning and validity of altmetrics.

Introduction

Traditionally, scholarly communication may be seen as a process that starts with a research idea and ends with a peer reviewed scientific publication being cited by other researchers, starting the process all over again with new ideas and new publications. Citations are part of formal scholarly communication and indicate use of earlier research; hence it can be argued that they tell us something about the value of the cited research, with the assumption that more valuable work is being cited more. Counting citations is at the very core of scientometric research methods and they have been used to measure various aspects scholarly work, impact

of research and to map scholarly networks (e.g. Moed et al., 1995; Cole, 2000; Borgman, 2000). Scientometric methods and tools are used in research evaluation (e.g. Garfield, 1972; Moed et al., 1985; Moed et al., 1995) although they were not originally designed for the task. Many of the traditional scientometric indicators and informetric research methods were developed as tools for libraries and for researchers, not as tools for decision making about research funding, and because of that they may not always be up for the task. Publishing and citation traditions vary between disciplines, and hence citations may not be the best representation of impact or influence for every discipline. It can also take a long time before a research idea is published as a scientific article and be recognized and cited by others, which means that it takes a long time before the value of a research product can be evaluated. In fact, it is usual that researchers choose a time period some years back in time (e.g., citations to publications in information science in 2010-2012), to make sure all citations to the researched publications have been registered. Social media may provide some means for more democratic evaluations with more timely data. The traces that informal and formal scholarly communications leave in social media may provide access to more timely data about use and visibility of research products.

Piwowar (2013) states that today there are more diverse research products than ever before, including the visibility and mentions research receives on various social networking sites, such as Twitter, YouTube, Mendeley, Pinterest, Facebook, and many more. Facebook and Twitter have been suggested to promote information sharing (Forkosh-Baruch & Hershkovitz, 2011), while social bookmarking sites such as Mendeley have been suggested to be potential data sources for altmetrics (Priem & Hemminger, 2010). Both Bar-Ilan et al. (2012) and Mohammadi and Thelwall (2013) have discovered a correlation, although not very strong, between social bookmarks on Mendeley and citation counts. Earlier research has shown that articles that are mentioned in Wikipedia have higher citation counts (Evans and Krauthammer, 2011). Scholarly blogs have also been found to have an important role in disseminating research (Kjellberg, 2010) and so called blog citations have been suggested as an altmetric measure (Shema et al., 2014). In a study about TED (Technology, Entertainment, Design) talks on YouTube Sugimoto et al. (2013) and Sugimoto and Thelwall (2013) discovered that although the TED talks popularize research they have little impact in promoting a researcher's work among their peers. The results showed that *"giving a TED presentation appeared to have no impact on the number of citations subsequently received by an academic, suggesting that although TED popularizes research, it may not promote the work of scientists within the academic community"*. Thelwall et al. (2013a) found significant associations between higher citation rates and higher metric

scores for several different social media, including Twitter, Facebook wall posts, blogs, mainstream media and forums. However, the coverage of research related content, and therefore alternative measures of research activities, was found to be low in all social media sites researched, except for Twitter, suggesting that Twitter might be a valuable source of altmetrics. But a correlation between altmetrics and citation counts alone do not necessarily mean that both metrics measure quality of research products. Sud and Thelwall (2014) state that it is up to the researcher to prove that there is a connection between research quality and altmetrics. They write that: *“To help show that altmetrics predominantly reflect research quality, it is also important to attempt to show that (a) common biases have a relatively small influence in comparison to research quality, and (b) that there is a connection between research quality and altmetric scores.”*

In addition to the seemingly good coverage of scientific content Twitter has also found a place in the communication infrastructure that researchers use during conferences to share information with their followers and for conversations with colleagues (Ebner & Reinhardt, 2009). Tweets submitted during and in relation to scientific conferences contain a mixture of questions, comments, notes, shared links and conversations (Ross et al., 2010), at least for the conferences studied. On the other hand Twitter is a way to expand the conference venue and to enable communication with members of the wider community. Nevertheless, conference tweeting usually only targets peers that already know the conference hashtag (Letierce et al., 2010). Beyond that, Twitter seems to be particularly suited for research information sharing as it provides an easy way to share information to ones followers, who in their turn can forward the information to their followers. Twitter also makes an excellent object for study as researchers can to some extent download and filter tweets through the Twitter API.

Data from the social web has been used as early indicators of impact and awareness of various research activities and research products. Although some studies have reported correlations between specific altmetric indicators and more traditional measures of impact, such as citations, there is still a lack of scientific evidence that specific altmetric indicators could function as valid proxies of quality.

Earlier altmetric research

Scholarly communication is changing as researchers increasingly use social media for various research activities. Researchers are using social media tools for various purposes, such as collaborative authoring, instant messaging and scheduling meetings, as well as for discovering

new research ideas and sharing their own or others' research results (Rowlands et al., 2011). Before the web and social media this kind of informal scholarly communication left only few traces or no traces at all, while today in social media these traces can be automatically collected and mined for new knowledge about attention or visibility a certain research product receives. Regardless of discipline researchers can share information about their work in blogs, on Twitter or on Facebook, and they can do so long before the research has been formally published as a traditional scientific publication. Because of this it would seem reasonable to assume that measuring visibility or impact of research in social media would be more democratic than using citations that depend on the publishing traditions of the discipline. However, Rowlands et al. (2011) showed that there are some disciplinary differences in how researchers are using social media in general and more recently clear disciplinary differences in how researchers are using Twitter in scholarly communication were discovered (Holmberg & Thelwall, 2014). The results from Holmberg and Thelwall (2014) showed that whilst researchers in biochemistry, astrophysics, cheminformatics and digital humanities seemed to use Twitter for scholarly communication, scientific use of Twitter in economics, sociology and history of science appeared to be marginal. The authors concluded that *“it seems to be worrying that some disciplines seem to be avoiding it [use of Twitter] almost completely for scholarly communication despite other disciplines seeming to find it useful for this purpose”*. It was also discovered that biochemists retweeted substantially more than researchers in the other researched disciplines and that researchers in digital humanities and cognitive science used Twitter more for conversations, while researchers in economics shared the most links. This shows that results from studies of social media use in a single discipline or a specific group of researchers cannot be generalized to other disciplines and research areas, but this may be changing as more researchers start to use social media for work related activities. The discovered disciplinary differences also suggest that research evaluation using social media data may not after all be more democratic.

The second argument supporting benefits of altmetrics is that it provides more timely data. Tweets and mentions on Facebook can be shared immediately after the publication of a research product. In fact, earlier research has shown a connection between the numbers of tweets about research articles on Twitter and the numbers of citations those articles later receive (e.g. Eysenbach, 2011; Shuai, Pepe and Bollen, 2012). Eysenbach (2011) found that highly tweeted papers in one open access online medical journal tended to receive more citations later on. Shuai et al. (2012) found that the number of tweets about an article correlates with downloads and early citation counts for preprint articles on Arxiv. The

connection between citations and attention received in social media cannot be argued, however, the underlying reasons for the connection remain unclear. Thelwall et al. (2013a) found statistically significant associations between *“higher metric scores and higher citations for articles with positive altmetrics scores”*. However, time of tweeting and time of article publication may be significant for the results, as *“comparisons between citations and metric values for articles published at different times, even within the same year, can remove or reverse this association and so publishers and scientometricians should consider the effect of time when using altmetrics to rank articles”*. This shows that the correlation between altmetrics and citation counts is dependent on the time of data collection, and the time of data collection may have a significant impact on the results. It is also unclear whether the number of tweets increases the later number of citations or if the number of tweets is higher for some articles because the articles are simply better, which later leads to more citations. This relates to the question about how attention in social media is created: why do people tweet and share information about certain research publications? Haustein et al. (2013) provides one explanation for this.

Haustein et al. (2013) investigated how often Twitter is used to disseminate information about journal articles in the biomedical sciences. Their analysis was based on 1.4 million documents covered by both PubMed and Web of Science and published between 2010 and 2012. The number of tweets containing links to these documents was analyzed to evaluate the degree to which these documents were represented on Twitter. The results showed that less than 10% of PubMed articles were mentioned on Twitter and that many of those that were highly tweeted were probably highly tweeted *“because of their curious or humorous content, implying that these tweets are mostly made by the ‘general public’ rather than the scientific community”*. Correlations between tweets and citations were also low, implying that impact metrics based on tweets are different from those based on citations. This was also confirmed in a pilot study investigating tweets to scholarly articles that discovered that tweets generally did not provide much more than publicity for the article and that the contents of the tweets themselves were unlikely to give any deep insights into scientists' reactions to the articles, i.e. whether they found the article useful or not, or valuable or not (Thelwall et al., 2013b). Weller et al. (2011) argued that mentions in tweets may not serve the same purpose as citations in scientific articles, in fact perhaps social media could complement traditional citation metrics and provide new information about how the public discovers and shares research. In the light of current research this assumption seems reasonable. Articles that get tweeted a lot do not seem to be highly tweeted because they are “better” or more valuable for other researchers,

but rather because they are interesting (for one reason or another) to wider audiences. Only a few studies have investigated the underlying reasons for mentioning research products in social media.

In an in-depth analysis of researchers' tweeting practices Haustein et al. (2014) discovered that the more researchers tweet the less they publish, and vice versa. This was the case at least for the studied 37 astrophysicists. The study compared data collected from Twitter and publication data from Web of Science and discovered a moderate negative correlation ($\rho = -0.390^*$) between the number of publications and tweets written by astrophysicists per day. Haustein et al. (2014) also analyzed whether the content of tweets would correlate with the content of the abstracts of the publications from these astrophysicists, but the similarity between tweets and abstracts was very low ($\cos = 0.081$). The results showed that impact on Twitter can neither be equated with nor replace traditional research impact metrics because the two indicate very different activities. The tweets from the astrophysicists did not reflect their publications or their publishing activity, however, it is possible that the tweets were rather a popularization of their research (and research by other astrophysicists), aimed at the wider audience. The authors concluded that *"tweets and other so-called altmetrics might be able to reflect other impact of scientists such as public outreach and science communication"*. This may be an indication that scholarly communications at least in Twitter are meant not only for other researchers, but for the general public, and hence it is possible that the real value in scientific use of social media lies in science communication to the general public.

In another in-depth study about astrophysicists use of Twitter Holmberg et al. (under review) analyzed the conversational connections the researchers had on Twitter and the content of their conversations. It was discovered that the professional composition of the conversational connections the astrophysicists have on Twitter contains a wide variety of different user types (e.g., colleagues, science communicators, researchers from other disciplines, educators, and students). The results showed that different communities with different professional compositions use very similar language, although they do not talk to each other (i.e. mention each other in the tweets). Interestingly, it was also discovered that in the communities that tweeted more the sentiment of the tweets tended to be neutral, compared to slightly positive sentiment among those that tweet less frequently. This suggests that frequent tweeting is connected to information sharing, rather than conversations or expressing personal opinions about the matter at hand. This is supported by the results from another study suggesting that researchers tend to share more links and retweet more than the average Twitter users, which may mean that they are sharing more links to scientific content and that information sharing is

the main purpose of using Twitter (Holmberg & Thelwall, 2014). A combination of the variety in the professional compositions of the conversational networks, tweeting mainly for information sharing, and a weak connection between the content of the tweets and the scientific output of the tweeting researchers, provides strong evidence against using altmetrics for research evaluation, but at the same time, suggests at its potential to measure attention or visibility of research products to wider audiences.

Discussion

Early altmetric research has shown that at least in some cases mentions and visibility in social media correlate with citation counts, but at the same time research has shown that the traces from scholarly activities in social media and the attention different research products receive in social media do not necessarily have anything to do with impact or quality of that research. Altmetrics can however indicate some other aspects of research activities, like awareness and attention from the general public. It can also be argued that nor should altmetrics be used to measure research impact or quality. A problem that has frequently been discussed during the breaks at informetric conferences is the fear that the minute altmetrics will become accepted as a tool for research evaluation (and funding decisions) researchers will start gaming the numbers. Inflating ones visibility on the web is easy. One could create multiple anonymous Twitter accounts to frequently retweet their own research related tweets or create fake blogs and websites that link to their own research articles in order to improve the ranking in search engines. But how likely is it that researchers or publishers would begin to game altmetrics? And is it possible to detect the gaming of altmetrics? As one solution to counter any gaming of altmetrics it has been suggested that altmetrics should be developed further to help and be part of peer-review, as altmetrics alone cannot be used as a metrics for research evaluation (Rousseau & Ye, 2013). Rousseau and Ye (2013) propose that combining informetric data (including altmetrics, or influmetrics as they suggest) with peer review is necessary for academic evaluation of any form.

When looking at the results from earlier research we can conclude that altmetrics does not stand for alternative metrics, as these social media based metrics do not provide a real alternative for citation based analysis of research impact. Altmetrics indicate something else, a different aspect of research activities, perhaps that of visibility and interest among a wider audience. The results from earlier research also present an argument that transformations in the scholarly communication system affect not only how scholars interact, but also the very

substance of these communications, at least in some cases as the audience for the communications is no longer just other researchers but the general public.

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