Evaluating the impact of research using the altmetrics approach (case study: the field of scientometrics)

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Evaluating the impact of research using the altmetrics approach

(Case study: The field of Scientometrics)

Abstract

Purpose – The main objective of this research is to assess the impact of research in the field of scientometrics using the altmetrics (social media metrics) approach.

Design/methodology/approach – This is an applied study using scientometric and altmetrics methods. The research population consists of the articles and their citations published in the two core journals (Scientometrics, Journal of Informetrics) in a period of five years (included 1738 papers and 11504 citations). Collecting and extracting the articles directly was carried from Springer and ScienceDirect databases. The Altmetric Explorer, a service provided by Altmetric.com, was used to collect data on articles from various sources (http://www.altmetric.com/). The research articles with the altmetric scores were identified (included 830 papers). The altmetric scores represent the quantity and quality of attention that an article has received on social media. The association between altmetric scores and citation indicators was investigated using correlation tests.

Findings – The findings indicated a significant, positive and weak statistical relation between the number of citations of the articles published in the field of scientometrics and the altmetric scores of these articles, as well as the number of readers of these articles in the two social networks (Mendeley and Citeulike) with the number of their citations. In this study, there was no statistically significant relationship between the number of citations of the articles and the number of readers on Twitter. In sum, the above findings suggest that some social networks and their indices can be as representations of the impact of scientific papers, similar citations. However, due to the weakness of the correlation coefficients, the replacement of these two categories of indicators is not recommended, but it is possible to use the altmetrics indicators as complementary scientometrics indicators in evaluating the impact of research.

Originality/value – The study of the impact of research in social media by using appropriate measures reflects not only the social impact of publications on authors, but also helps libraries, universities, research organizations and politicians in planning, budgeting and allocating resources.

Keywords - Research evaluation, Social media, Citation indicators, Altmetrics indicators, Scientometrics

Paper type- Research paper

1. Introduction

For many years, citation analysis is used to investigate the scientific effectiveness of researchers. Although citation-based indices are among the most accepted and important indicators for assessing performance and scientific effectiveness, there have always been some deficiencies in these indices. The fact that citations take time to accumulate also has an impact on research evaluation, as a wait of a few years after publication is needed before the impact of papers can be measured (more in some disciplines). As a result, many have turned to Journal Impact Factors as a proxy for the potential citation value of articles within journals; however, due to the skewness of citation distributions, journal measures should not be used as article-level indicators (Neylon, 2009). Additionally, the relationship between citations and the Impact Factor is weakening, so alternative metrics have been developed to respond to these challenges

(Thelwall, 2013). On the other hand, due to the widespread use of social media in the scientific fields, new indicators called altmetrics indices along with the traditional scientometrics concepts (citation analysis) have been created to investigate the impact of research activities in social media.

Altmetric was founded by Euan Adiein 2011. Previously a researcher, Adie had already worked on Postgenomic.com, an open source scientific blog aggregator founded in 2006. In 2011 Adie entered an altmetrics app into Elsevier's Apps for Science competition and won. Altmetric.com (http://www.altmetric.com/) is a commercial London-based tool that tracks, analyses and collects the online activity around scholarly outputs from a selection of online sources such as blogs, Twitter, Facebook, Google+, mainstream news outlets, media and other sources (Adie & Roe, 2013). Altmetric.com compiles all the social media attention gathered by a scientific publication in the so-called 'altmetric donut' or altmetric score. The altmetric score reflects both the quantity (the higher attention, the higher score) and quality (weighting according to different sources) of attention received by each item applying some kind of normalization1 (both by all articles of similar age and in the same journal (Costas & et al. 2014). Altmetric employs an algorithm to assign each item an automatically calculated score. Based on the volume and source of attention an item has received, the score is intended to reflect the reach or popularity of the research output.

Alternative measurements are currently one of the most popular research topics in scientometric investigation and the focus is moving from web citation analysis to social media usage analysis (Li, Thelwall, & Giustini, 2012). The thought behind the altmetrics is that the web is not just used by academicians and therefore data from the web about scholarly research may be useful as evidence of the wider impacts of the research. Altmetrics additionally holds potential value for financing plan assessments. Some alternative indicators have advantages to usefully complement scientometric data by reflecting a different type of impact or through being available before citation data that can be used by funding agencies as part of their funding scheme evaluations.

There are already a number of studies concerning altmetrics. An overview of these studies can be found in Bar-Ilan, Shema, and Thelwall (2014), Haustein (2014), and Priem (2014). Many of these studies have measured the correlation between citations and altmetrics. Since the correlations were often at a moderate level, the results are difficult to interpret: Both metrics seem to measure something similar but not identical. The studies published so far cannot yet provide a satisfactory answer to the question whether altmetrics is appropriate for the measurement of societal impact or not. That is the reason for this investigation of the question (Bornmann, 2014).

Some of these studies are described below.

Works like Thelwall et al. (2013); Li and Thelwall(2012); Li et al. (2012); Bar-Ilan (2012) have investigated the correlation between altmetrics and traditional bibliometric indicators. In general, these studies have found moderate agreement (i.e. 0.6 with Spearman correlation coefficient) with specific sources of altmetrics, i.e. Mendeley and Twitter. According to Thelwall (2018), the number of Mendeley readers tends to correlate better with synchronous citation counts after a few years. These results have been confirmed also by the meta-analysis conducted by Bornmann (2015) that concluded that the correlation with traditional citations for micro-blogging is negligible, for blog counts it is small, and for bookmark counts from online reference managers, it is medium to large. Nevertheless, none of these studies analyses the correlation between altmetrics and traditional bibliometric indicators by also taking into account quality assessment procedures performed by peers. These procedures are typical of many academic evaluation systems in different countries across the world. Notably, works like Wouters et al. (2015); Ravenscroft et al. (2017); Bornmann and Haunschild (2018) perform this kind of analysis. More specifically, Wouters et al. (2015) correlate different metrics with the output of the Research Excellence Framework (REF) held in 2014 in the UK. The REF is the reference system for assessing the quality of

research in UK higher education institutions. The analysis is performed with different traditional and alternative metrics and the outcomes available for different research areas converge towards limited or none correlation. Finally, the aim of the analysis carried out by Bornmann and Haunschild (2018) is twofold. In fact, first the authors in Bornmann and Haunschild (2018) measure the correlation between citation counts and altmetrics by using Principal Component Analysis and Factor Analysis. Then, they test the relationship between the dimensions and quality of papers using regression analysis on post-publication peer-review system of F1000Prime assessments. The results of the first part show how the count of Mendeley readers and tweets are related to citation count, while the regression analysis shows that only Mendeley readers and citation count are significantly related to quality. None of the aforementioned works present a comprehensive analysis investigating not only the correlation between traditional indicators and altmetrics, but also the correlation among the altmetrics themselves. The latter perspective is relevant in order to understand how to eventually use altmetrics as well as traditional indicators to support peers in quality assessment procedures of research outcomes.

Costas et al. (2015) employed more than 1.5 million of publications from Altmetric.com and Web of Science to analyze the relationship between altmetric and bibliometric indicators. They detected that social network metrics (Facebook, Twitter, Goggle+ mentions) were located in a different component from social media (blogs, news). Li and Fred (2015) analyzed 66 Library and Information Science journals, but they did not find differences among metrics. However, there is much less studies that had used different data providers, and most of them were articles focused on comparing the coverage of each tool (Jobmann et al., 2014; Zahedi et al., 2015).

The study of the impact of research in social media by using appropriate measures reflects not only the social impact of publications on authors, but also helps libraries, universities, research organizations and politicians in planning, budgeting and allocating resources. Considering the important role of evaluating the impact of research in the field of Scientometrics, and since this field of study has been less studied from the point of view of altmetrics, this research evaluates the impact of research in this field by Altmetrics method. This research has attempted to answer the question of whether altmteric indicators can be used as a substitute or complementary of citation index for assessing the impact of research? The findings of this research can complement the results of the previous studies on the evaluation of international research in the field of Scientometrics.

2. Research questions

RQ1. What is the presence rate of the articles published in the core journals of Scientometrics in social media?

RQ2. What is the state of the altmetric scores of the articles published in the core journals of Scientometrics?

RQ3. What are the most effective articles in the field of Scientometrics based on altmetric indicators?

RQ4. Which media are the most important social media in the field of Scientometrics?

RQ5. Is there a significant statistical relation between the presence of international articles in the field of Scientometrics in social media and the number of the paper citations?

RQ6. Can altmteric indicators be used as a substitute or complementary of citation index for assessing the impact of research?

3. Methodology and data gathering

This is an applied research using the altmetrics (social media measures) method. The research population consists of the articles and their citations published in two core journals in the field of Scientometrics ("Scientometrics" journal, Journal of Informetrics) in a period of five years (2012-2016). The articles, their citation, and their altmetric data were collected and extracted in two steps. In the first step, these articles and the citations counts of each paper directly were collected from Springer and ScienceDirect databases. Then, in the next step, in order to determine the presence rate of the retrieved articles in social media, each article was manually searched using the altmetric bookmarklet. This tool is a service provided by Altmetric Institute was used for data collection. This tool stores as a bookmark in web browsers and provides Altmetrics data. To use this tool, we need to select the article's DOI on the homepage of the article and click on the bookmark stored on the web browser. Accessible with one click via the Altmetric donut badges, the details page for each research output gives a full record of all of the original shares and mentions of an individual piece of scholarly content.(Figure 1).

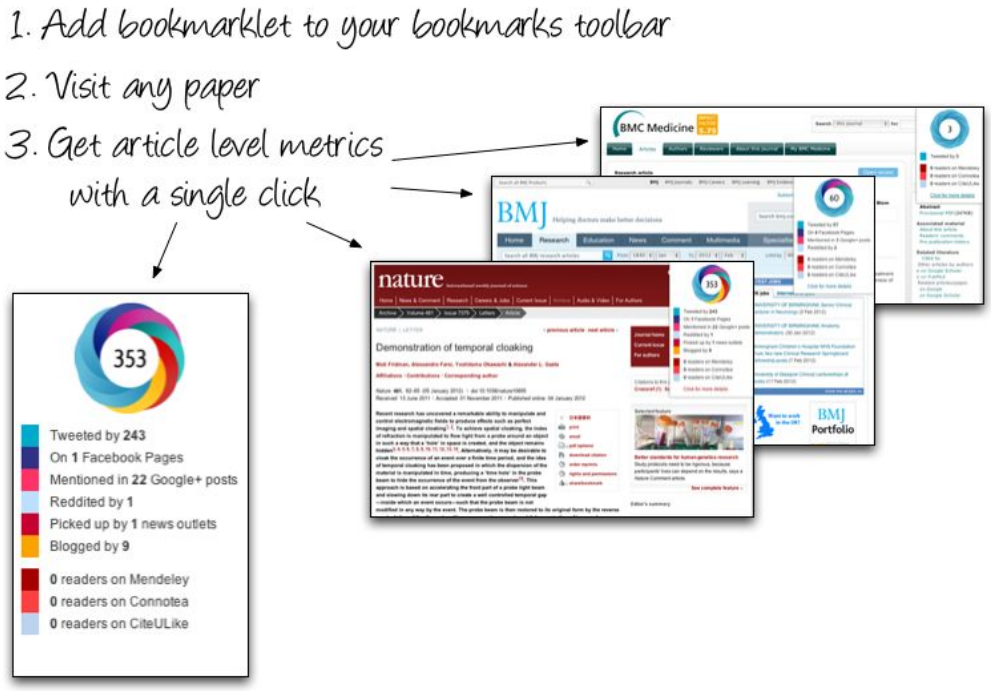

Figure 1-Extracting altmetric scores of papers using the Altmetric bookmarklet tool

The research articles with the highest altmetric scores were identified. In this step the collected data were stored in two excel files separately for each of the two studied journals. Finally the association between altmetric scores and citation counts was investigated using correlation tests. The results of these analyses are presented in the following.

4. Data analysis

●In this section, in order to answer the research questions, the results of the analysis of the retrieved data is presented. To answer the RQ1, the survey revealed that of a total of 1342 papers retrieved from "Scientometrics" journal, 643 papers (48%) have been shared at least once in social media and have an altmetric score (table I). Also the gathered data from "Journal of Informetrics" shows that of a total of 396 papers retrieved, 188 papers (47.4%) have been shared at least once in the social media and have an altmetric score (table I). This table shows the number of citations of the articles with the altmetrics

indicators, for “Scientometrics” journal’s papers and “Journal of Informetrics”s papers is 4565 and 1670, respectively. In this case the average number of citation for per Sci. articles is 7 and for per Info. articles is 9. On the other hand, the number of citations of the articles without the altmetrics indicators for above journals is 3842 and 1685, respectively. In this case the average number of citation for per Sci. articles is 5 and for per Info. articles is 8. These results indicate that there is no significant difference in citability between the articles with and without altmetrics indicators.

Table I- The presence rate of international articles in the field of scientometrics in the social media

Publication year	The number of articles		The number of citations		The number of articles with the altmetrics indicators		The number of citations for the articles with the altmetrics indicators		The number of citations for the articles without the altmetrics indicators	
	Sci.	**Info.**	**Sci.**	**Info.**	**Sci.**	**Info.**	**Sci.**	**Info.**	**Sci.**	**Info.**
2012	245	63	2335	1006	105	17	1282	386	1053	620
2013	250	93	2203	1101	105	39	1170	568	1033	533
2014	336	79	2213	619	130	28	1157	292	1056	327
2015	238	80	937	434	134	43	613	282	573	152
2016	273	81	461	195	169	61	343	142	127	53
total	1342	396	8149	3355	643	188	4565	1670	3842	1685

The presence rate of international articles in the field of Scientometrics in the social media by publication year is shown in Figure 2.

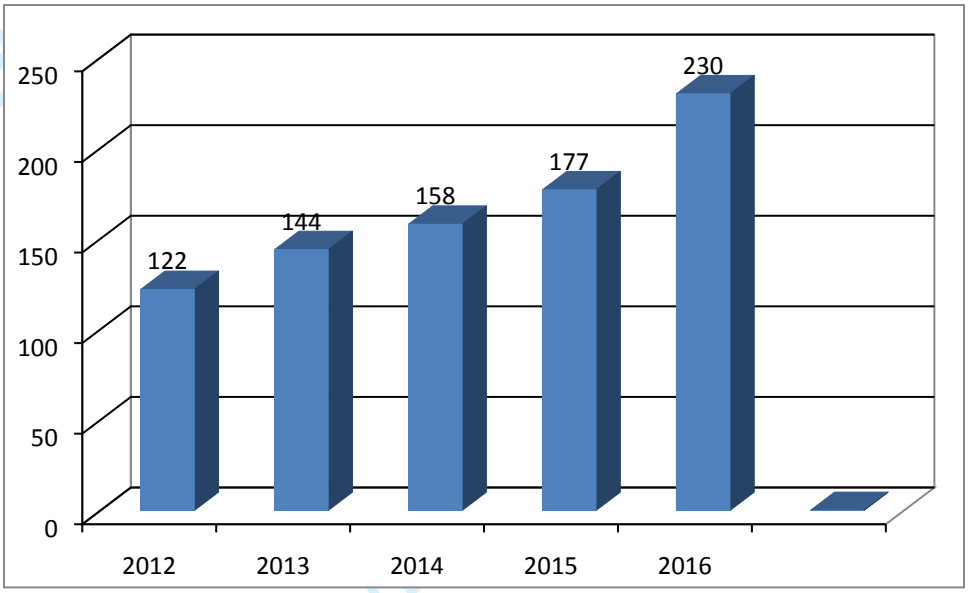

Figure 2. The presence rate of international articles in the field of Scientometrics in the social media by the publication year

● The Altmetric database which is one of the most important altmetrics service providers, examines the presence rate of an article in various social media. The basis of the work is that any discussion on blogs, news and Q & A sites has different points for an article. Of all these points, a general altmetric score is given that indicates the rate of sharing and use of the article in social media. In other words, the altmetric score indicates the quantity and quality of attention an article received in various social media. To answer RQ2 the analysis of the retrieved data from "Scientometrics" journal show that the maximum and minimum altmetric scores of articles are 208 and 1, respectively. The highest average altmetric scores are for the articles published in this journal in 2016. The maximum and minimum altmetric scores for "Journal of Informetrics"'s articles are 200 and 1, respectively. The highest average altmetric scores are for the articles published in this journal in 2012 and 2013. Table II shows the status of the altmetric scores of the articles by the publication year using altmetric database[1].

Table II. The status of the altmetric scores of the articles by the publication year (using altmetric database)

The Publication year	Maximum of the altmetric score		Minimum of the altmetric score		Average of the altmetric score	
	Sci.	Info.	Sci.	Info.	Sci.	Info.
2012	208	200	1	1	5.98	16.17
2013	38	69	1	1	4.11	10.69
2014	43	19	1	1	5.04	4.03
2015	118	45	1	1	5.08	6.38
2016	83	87	1	1	7.18	6.83

[1] https://www.altmetric.com/

To answer RQ3, table III presents the most effective articles in the field of Scientometrics based on the altmetric indicators.

Table III. The most effective articles in the field of Scientometrics based on the altmetric scores

Rank	The article title	Authors	The publication year	The altmetrics score	The papers citations	The journal title
1	Negative results are disappearing from most disciplines and countries	Daniele Fanelli	2012	208	185	Scientometrics
2	Exploring scientists' working timetable: Do scientists often work overtime?	Xianwen Wang ,Shenmeng Xu, Lian Peng, Zhi Wang, Chuanli Wang, Chunbo Zhang ,Xianbing Wang	2012	200	19	Journal of Informetrics
3	Methods for estimating the size of Google Scholar	Enrique Orduna-Malea, Juan M. Ayllón, Alberto Martín-Martín, Emilio Delgado López-Cózar	2015	118	13	Scientometrics
4	Hybrid open access—A longitudinal study	Mikael Laakso, Bo-Christer Björk	2016	87	1	Journal of Informetrics
5	Tracking the digital footprints to scholarly articles from social media	Xianwen Wang, Zhichao Fang, Xinhui Guo	2016	83	2	Scientometrics
6	A bibliometric analysis of academic publication and NIH funding	Jiansheng Yang ,Michael W. Vannier, Fang Wang ,Yan Deng , Fengrong Ou ,James Bennett ,Yang Liu, Ge Wang	2013	69	12	Journal of Informetrics
7	Validating online reference managers for scholarly impact measurement	Xuemei Li, Mike Thelwall, Dean Giustini	2012	66	0	Scientometrics
8	The advantage of simple paper abstracts	Adrian Letchford, Tobias Preis, Helen Susannah Moat	2016	61	5	Journal of Informetrics
9	Universality of scholarly impact metrics	Jasleen Kaur, Filippo Radicchi, Filippo Menczer	2013	60	31	Journal of Informetrics
10	Grand challenges in altmetrics: heterogeneity, data quality and dependencies	Stefanie Haustein	2016	57	10	Scientometrics

To answer RQ4, the most important social media published the articles in the field of Scientometrics, was studied. The results show out of 1342 articles retrieved by the "Scientometrics" journal, 643 papers (47.9%) were shared by Mendeley, one of the social tools for managing references. Other important social media used by Scientometrics scholars are: Twitter with 592 articles (44.1%) and "CiteULike" with 104 articles (7.7%). Also, out of 396 articles retrieved by the "Journal of Informetrics", 188 articles (47.4%) were shared by Mendeley , 175 articles (44.1%) by Twitter and 35 articles (8.8%) by CiteULike. Table IV shows the most important social media published the Scientometrics articles based on the publication year. Figure 3 shows the presence rate of the Scientometrics articles in other social media using altmetric database.

Table IV. The most important social media published the Scientometrics articles based on the publication year

The publication year	The number of readers in Mendeley		The number of readers in Twitter		The number of readers in CiteULike	
	Scientometrics	Journal of Informetrics	Scientometrics	Journal of Informetrics	Scientometrics	Journal of Informetrics
2012	105	17	97	16	37	7
2013	105	39	91	37	19	7
2014	130	28	116	24	19	7
2015	134	43	124	39	13	10
2016	169	61	164	59	16	4
total	643	188	592	175	104	35

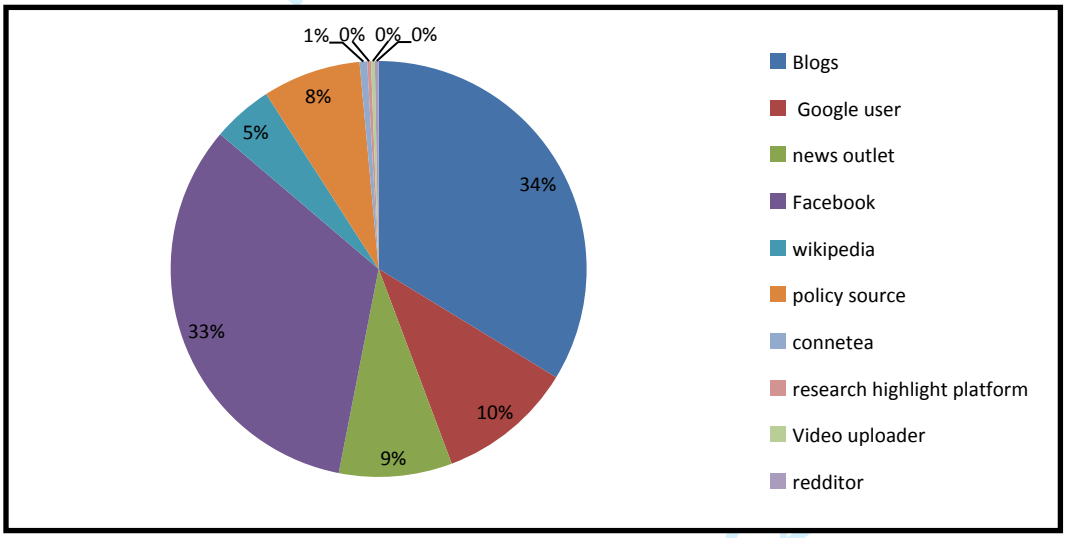

Figure 3. The presence rate of Scientometrics articles in other social media using altmetric database

To answer RQ5, due to the non-normality of the distribution of data, Spearman correlation test was used to investigate the relationship between the presence of international articles in the field of Scientometrics in social media and the number of paper citations, as well as to test the research hypothesis. To this end, data related to the mean altmetric score of the studied articles and the number of the papers citations were entered into SPSS software and then the Spearman rank correlation test was performed. The results of these analyses are presented in table V. As can be seen, the results of the correlation test show a statistically significant positive and weak correlation between the studied variables. The relationship between the number of articles citations and the altmetric score of the articles ($p = .000$ and $r = 0.145$) indicate that with increasing the number of citations, the altmetric score of the articles also increased. Also, the results of the correlation test indicated a significant, positive and mean statistical relationship between the number of readers of articles in Mendeley and the number of the received citations ($p = 0.000$ and $r=0.572$), as well as the number of readers of articles in the CiteULike and the number of the received citations ($p= 0.000$ and $r= 0.314$). These findings suggest that with the increase in the number of

the article citations, the number of readers of these articles has also increased in some scientific networks such as Mendeley and CiteULike. However, there was not a significant relationship between the number of the readers of the articles on Twitter and the number of the received citations (p=0.302 and r = 0.37).

Table V. The results of the correlation test between the total number of the papers citations and their altmetric scores

The number of the paper citations		The altmetric score of the articles	The number of the readers in Mendeley	The number of the readers in CiteULike	The number of the readers in Twitter
	P value	0.000	0.000	0.000	0.302
	Spearman correlation	0.145	0.572	0.314	0.37

Also, the correlation test results for the pairs of altmetric scores showed a significant, positive and moderate relationship between the number of article readers in Mendeley and CiteUlike (p = 0.000 and r = 0.437)(Table VI) and a significant, positive but weak relationship between the article readers in Mendeley and Twitter (p = 0.000 and r = 0.109)(Table VII). There was no significant relationship between the number of readers of articles on CiteUlike and Twitter (p = 0.090 and r = 0.141) (Table VIII).

Table VI. The results of the correlation test between the the number of article readers in Mendeley and CiteUlike

Correlations				
			Mendeley	CiteUlike
Spearman's rho	Mendeley	Correlation Coefficient	1.000	.437**
		Sig. (2-tailed)	.	.000
	CiteUlike	Correlation Coefficient	.437**	1.000
		Sig. (2-tailed)	.000	.
**. Correlation is significant at the 0.01 level (2-tailed).				

Table VII. The results of the correlation test between the the number of article readers in Mendeley and Twitter

Correlations				
			Mendeley	Twitter
Spearman's rho	Mendeley	Correlation Coefficient	1.000	.109**
		Sig. (2-tailed)	.	.002
	Twitter	Correlation Coefficient	.109**	1.000
		Sig. (2-tailed)	.002	.
**. Correlation is significant at the 0.01 level (2-tailed).				

Table VIII. The results of the correlation test between the the number of article readers in CiteUlike and Twitter

Correlations				
			Twitter	CiteUlike
Spearman's rho	Twitter	Correlation Coefficient	1.000	.141
		Sig. (2-tailed)	.	.090
	CiteUlike	Correlation Coefficient	.141	1.000
		Sig. (2-tailed)	.090	.

To answer RQ6, it is assumed that those scientific social media, in which there is a significant correlation between the articles citations and their bookmarkings, are likely to have the potential to be used as an alternative or complementary tool in the evaluation of research. Hence, some scientific social networks such as Mendeley and CiteULike can be used as complementary and not a substitute for evaluating the impact of research. But for the networks such as Twitter, this assumption was not met.

5. Results

The summary of results obtained from data analysis in this study is described below:

● The presence rate of the studied articles in social media is about 48% of the total number of the retrieved articles (Table I). A review of the results of the previous studies suggests that the altmetric coverage of research outputs has been different based on the type and nature of the studied subject area, the type of social media and the database used to collect altmetric data(Holmberg, 2015). Comparing the results of this study with some previous studies in other subject areas (Zahedi, Costas, & Wouters, 2014 Mohammadi, Thelwall, 2014, Haustein, Costas, Larivière, 2015), it can be said that the research outputs in the field of Scientometrics have a relatively good altmetric coverage.

● The frequency of the articles with altmetric indicators based on the publication year, indicates the prevalence of the use of social media by researchers in recent years. This finding seems logical, because the use of social media has been steadily expanding, especially in recent years, and also the focus of the Altmetric Institute's data is on the documents published since 2011. The increase in the presence of scientific productions in social media in recent years has also been reported in the study of Costas and others (2014).

● The most important social media published the articles in the field of Scientometrics are Mendeley (46.88%), Twitter (44.87%), and CiteULike (7.99%) (Table IV). Thus, Mendeley has a good coverage of the articles in the field of Scientometrics and can be used in the future research. Previous researches (Zahedi, Costas & Wouters 2014; Priem et al. 2012; Li et al. 2012) also referred to Mendeley and Twitter as one of the most important tools for providing article-level data and altmetric information. The other social media published the articles in the field of Scientometrics are respectively Blog, Facebook, Google Plus, News outlet, Policy source, Wikipedia, Connetea and Reddit (Figure 2).

● The research findings indicate that there is a significant, positive and weak statistical relation between the number of the paper citations and the altmetric scores of these articles, as well as the number of the readers of the Scientometrics articles in Mendeley and CiteULike with the number of the paper citations (Table V). This finding is in accordance with the findings of Prime, Piwowar and Hemminger (2011), which reported a statistically significant relationship between the number of the received citations in the Web of Science and the number of downloads of documents in the “PLOS” scientific social network. Mohammadi and Thelwall (2014) also have a statistically significant relationship between the number of

the received citations in the WOS and the number of bookmarkings in the Mendeley social network. Also, Haustein and others (2013) found a moderate correlation between these two variables in Mendeley. These findings may indicate that the strength of the relationships and, consequently, the validity of altmetrics are different depending on the studied social network. In this study, there was no statistically significant relationship between the number of paper citations and the number of readers of articles on Twitter (Table V).

6. Conclusions

In sum, the findings of this research suggest that some social networks and their indices can be as representations of the impact of scientific papers, similar citations. However, due to the weakness of the correlation coefficients, the replacement of these two categories of indicators is not recommended, but it is possible to use the altmetrics indicators as complementary scientometrics indicators in evaluating the research and calculating the impact of research. As Bornmann (2011) and Rousseau (2013) have pointed out, if alternative metrics are used to evaluate research, these measures should be the same as scientometric indicators based on a specialized judgment process. Therefore, the results based on this type of evaluation should not only directly lead to decision making on research budgets, but also need to be used to assist experts in deciding on a specialized arbitration process.

The Altmetric score provides nontraditional metrics that are considered an alternative to the more traditional h-index or Hirsch index, which is an author-level metric that measures both the productivity and citation impacts of the publications of a scientist or scholar (Hirsch 2005). Social media can provide a measurement of early reaction to research because the time it takes to discuss such work on social media can be much less than the time it takes to acquire citation information. Also, social media can provide a more complete picture of the use of research than citation counts alone. Importantly, the Altmetric score is helpful to rank research outputs based on attention from various sources, but as Elmore (2018) has pointed out, it can't tell you anything about the quality of the article itself. It simply tracks attention, and attention can be good or bad. As an example, an article could be blogged about many times because of negative feedback. For research articles, some feel that if they get mentioned on social media, it's because they relate to popular topics, not because they are examples of good research. So, use and interpret the Altmetric score with care. It should be used in conjunction with impact factor, h-index, number of downloads, and citation counts to provide a more rounded picture of the article's impact.
It should be noted that in this research only the altmetrics performance of the studied articles was examined only on the basis of the data of one of the altmetrics data service providers (altmetrics database). In order to resolve the current study limitations, future research can perform the altmetric activity of other scholarly journals or other subject areas at different times and using data obtained from other altmetric data service providers and compare the results.

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