

Publication Performance and Trends in Altmetrics: A Bibliometric Analysis and Visualization

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Abstract

Bibliometric analysis of different fields of knowledge leads to a better understanding of the trend and quality of scientific products. The present study examined the publications on Altmetrics through bibliometric analysis and knowledge mapping. In this survey research, using quantitative indicators of scientometric, scientific developments in the field of altmetrics have been evaluated. The study population included all articles in the field of altmetrics (1077 documents) indexed in the Scopus database from the beginning to the end of 2020. The Excel and VOSviewer software packages were used to analyze the data. The findings show that scientific products in the field of altmetrics indexed in Scopus have been published since 2012; the quantitative trend of publications has been upward; Most of the scientific products in the field of altmetrics were original articles and in English. The United States, the United Kingdom, and Spain were the top and most productive countries in publishing documents in the field. Iran was ranked ninth with 52 documents. Regarding the number of publications, the University of Wolverhampton, the Administrative Headquarters of the Max Planck Society, and Leiden University were ranked first to third, respectively. Thelwall, M., with 42 articles, Bornmann, L., with 32 articles, and Haunschild, R., with 25 articles, were the most active authors. The most frequently used keywords were "Altmetrics", "bibliometrics" and "Social media". The highest number of documents in the field of Altmetrics has been published in the journal "Scientometrics". The most cited author was Thelwall, M., with 2691 citations. Due to the upward trend of scientific publications in Altmetrics and the beginning of its way, this upward trend will continue. Also, most of the top authors in the field are from universities and countries active in this field.

Keywords: Altmetrics, Bibliometric Analysis, Visualization, Scopus.

Introduction

The world of information is constantly changing, and reading and writing on the web play a crucial role in which "users can add, share, rank or regulate information" (Aletaha, Soltani & Dokhani, 2021; Drachsler, Hummel & Koper, 2008). The advent and development of the social web allow users to interact with new scientific outputs that were not previously possible (Ortega, 2015). These advances have created a new area for research called Altmetrics, which examines new data sources as global impact factors of researchers (Holmberg, 2015; Samie, Biranvand, Rahmaniyan & Varnamkhasti, 2022). Altmetrics was first introduced in 2010 by Priem, Taraborrelli, Grout and Nilan (Priem & Costello, 2010; Priem, Piwowar & Hemminger, 2012; Priem, Taraborrelli, Groth & Neylon, 2011). Altmetrics is an example of a web metric. This metric is used in non-traditional media for academic discourse, such as blogs, Wikis, Twitter, and various websites (Galligan & Dyas-Correia, 2013; Howard, 2012). Altmetrics typically looks at individual research outputs, including journal articles or datasets. Hence it can assess the impact of research outputs such as data publication and not just journal articles (Fenner, 2014). Altmetrics as "alternative metrics" to traditional bibliometrics indicators (Holmberg, Hedman, Bowman, Didegah & Laakso, 2020) is defined as "scholarly impact measures based on activity in online tools and environments" (Priem et al., 2011). This online activity around research outputs on various platforms on the web and in social media (e.g., Twitter, Facebook, and blogs) are widely analyzed as potential signals of research impact or online attention the research has received (Holmberg et al., 2020). Altmetrics is a complement to bibliometrics (Delli, Livas, Spijkervet & Vissink, 2017; Kolahi, 2015; Kolahi & Khazaei, 2018; Kolahi, Khazaei, Iranmanesh & Soltani, 2019; Kumar et al., 2018); but it works faster than traditional metrics (Priem et al., 2011). Therefore, authors do not need to spend a long time evaluating their works because even their unpublished works will be evaluated using these metrics. In general, the goal of Altmetrics is to broaden people's perception of the impact factor through new metrics and data sources. Altmetrics encompasses all stages and outputs of scientific research (from searching social texts on Facebook to sharing readers' published results on Twitter). It also uses a new method to measure the impact of authorship and publications that can complement traditional indicators (bibliometrics) in research evaluation. Altmetrics, on the other hand, can measure the impact of journal articles through social media activity. Altmetrics have four benefits compared to bibliometric methods: the diversity of dissemination channels analyzed, the speed of acquiring/retrieving data, the openness of methods, and the ability to measure impact beyond the 'scholarly realm' (Hammarfelt, 2014). However, Altmetrics has discovered new insights into the impact that was previously impossible to obtain (Priem et al., 2011).

Currently, the two web-based sites Altmetrics.org and Altmetric.com have an important role in promoting the use of Altmetrics. Altmetrics.org is considering upgrading altmetric apps such as ImpactStory, ReaderMeter, ScienceCard, and PLoS Impact Explorer, but Altmetric.com is a commercial website, collaborated with major publishers, which acts as an open tool and data to supply qualitative and quantitative data that complements traditional, citation-based measurements (Williams, 2017). For these websites, various social media platforms such as Twitter, Facebook, YouTube, LinkedIn, and Reference Managers (such as Mendeley) are used as data sources (Robinson-García, Torres-Salinas, Zahedi & Costas, 2014). It has been more

than a decade since the introduction of Altmetrics and publications on it. Given the importance of Altmetrics in evaluating scientific publications, the study of publications of Altmetrics, can help to understand the scientific structure of this field. One of the techniques used to analyze the knowledge structure in a particular field and to be aware of its evolution and identity is bibliometric analysis. Bibliometrics was invented by Alan Pritchard (1969) and is the application of mathematical and statistical methods to measure books and communication media. This field is now pervasive, and similar areas such as scientometrics, informetrics, and webometrics have originated from the field of bibliometrics (Biswas, Roy, & Sen, 2017; Pritchard, 1969). Diodato and Gellatly (2013) provided a clear and concise definition of bibliometrics: quantitative analysis of books, journal articles, and so on (Diodato & Gellatly, 2013). Potter (1981) considers bibliometrics as the study and measurement of publishing patterns of all forms of written communication, including their authors. Potter (1981) divides bibliometrics into two categories: (a) Descriptive bibliographic studies that count the participation of countries, authors, magazines, and so on; and (b) Evaluative bibliometric studies that try to study the use of texts by using citation analysis. Bibliometrics is also used to measure the scientific impact of journals, authors, and research institutes, as well as to identify important topics, emerging topics, highly cited sources, patterns of scientific collaboration, and so on.

Bibliometric analysis of a specific area can reveal its current status and dynamic trend and is helping to improve the quality of the area field further. In this regard, scientometric specialists are working to draw scientific maps of various areas through processing, extracting, and sorting information using scientometric techniques and providing analyzing, routing, and presenting knowledge. In addition, they use scientometric techniques to facilitate access to information and reveal and help knowledge seekers to achieve successful results (Khasseh, Amiri & Sadeghi, 2021). This study aimed to conduct a bibliometric analysis of research on Altmetrics and draw a scientific map of this field.

Literature Review

Bibliometric is a field of research with a long history. In recent years, many bibliometric studies have been conducted. Some bibliometric studies have investigated a topic or field based on their documents indexed in Scopus or Web of Science. For example, it can point out to following topics or fields: Digital Marketing (León-Castro, Rodríguez-Insusti, Montalván-Burbano & Victor, 2021), environmental communication (Wu, Long, Bai & Chen, 2021), environmental damage (Li, Liu, Zhang & Li, 2018), urban education (Liang & Wang, 2018), Welding (Layus & Kah, 2015), obesity publications (Aletaha et al., 2021), fuzzy research (Merigó, Gil-Lafuente, & Yager, 2015), information architecture (Taga, Oliveira Inomata, Rodrigues Vaz, Uriona Maldonado & Varvakis, 2017), medical research (Ndwandwe, Bishop, Wise, & Rodseth, 2021), Tuberculosis (Nafade et al., 2018), entrepreneurship (Landström, Harirchi & Åström, 2012), Nursing Research (Ghamgosar, Zarghani & Nemati-Anaraki, 2021; Khasseh et al., 2021) and ergonomics (Heidarimoghadam, et al., 2021).

Other bibliographic studies have investigated articles published in a particular journal. For example, it can point out to research in the following journals: DESIDOC Journal of Library & Information Technology and SRELS Journal of Information Management (Aich & Das, 2021), CA (Kavitha & Kumari, 2021), Library Philosophy and Practice (Anna, Anawati, & Azizi, 2021), Korean Journal of Anesthesiology (Lee, 2021), Journal of Infection and Public Health

(Krauskopf, 2018), Journal of Knowledge Management (Gaviria-Marin, Merigo & Popa, 2018), European Journal of Marketing (Martínez-López, Merigó, Valenzuela-Fernández & Nicolás, 2018), International Journal of Fuzzy Systems (Tang, Liao & Su, 2018), Journal of Oral Research (Corrales, Reyes, & Fornaris, 2016). Also, sometimes a certain country has been the subject of some bibliometric studies (Bueno-Aguilera, Jiménez-Contreras, Lucena-Martín & Pulgar-Encinas, 2016; Corrales-Reyes, Fornaris-Cedeño, Dorta-Contreras, Mejia, Pacheco-Mendoza & Arencibia-Jorge., 2019; Da Luz, Marques-Portella, Mendlowicz, Gleiser, Coutinho & Figueira, 2008; Huamaní et al., 2014).

As mentioned, the purpose of this study is a bibliographic analysis of publications in the field of Altmetrics. In the following, some similar studies in this field are briefly mentioned. Hebebcı (2021) examined the trend of articles indexed in the Web of Science on “distance education” during the COVID-19 epidemic using bibliographic and content analysis methods. The results of this study showed that most of the articles belonged to the United States, and most were published in the “Journal of Chemical Education” (Hebebcı, 2021). The results of a bibliographic study on deep web showed that the research on this has grown slower while it has grown better in the last four years. Based on this study China and Soochow University in this country, as well as “Chen H” from this country, had the largest number of articles in this field. Two keywords, “Learning Machine” and “cryptomarkets,” are contemporarily popular terms being used by deep web researchers, which indicate interest in these topics (Rai, Singh & Varma, 2020). Raban and Gordon (2020) investigated the evolution of Big Data (BD) and Data Science (DS) literature by bibliometric indicators. The results indicated a surge in BD publications along with a gradual increase in DS publications, and according to WoS Categories, the most covered research areas of BD and DS from 1965 to 2019, were “Computer science” (and subfields) and “Multi and interdisciplinary sciences” respectively (Raban & Gordon, 2020). Shonhe (2020) conducted a descriptive study to analyze the research output on the Continuous Professional Development (CPD) of librarians. The study results showed that the most productive countries in this research area are USA, the United Kingdom, and Australia; University of Nigeria and University of Sheffield were the most productive institutions; and Library Trends and Journal of Librarianship and Information Science is the most productive publisher (Shonhe, 2020). In a bibliometric study on Mobile Information Literacy in Higher Education (Pinto, Fernández-Pascual., Caballero-Mariscal, Sales, Guerrero & Uribe, 2019) found that the keywords “Information literacy” (with 181 repetitions), “Academic library” (with 90 repetitions), and “Distance education” (with 67 repeats) were the most frequent keywords used in documents of this field (Pinto et al., 2019). Rajeswari and Praveena (2019) in assessing the Digital Literacy research output using the bibliometric method, found that the maximum number of papers 126 was published in 2011. Journal of Adolescent & Adult Literacy journal placed in the first position with 18 records (Rajeswari & Praveena, 2019). Bhardwaj (2017) researched to map information literacy literature in social sciences and humanities published from 2001 through 2012 and found that 1990 documents originating from 79 countries were published in this field. Results also showed that the highest growth of publications was in 2005, and the USA contributed the highest number of documents in this field. In total, 160 institutions worldwide have contributed to information literacy research. The University of Strathclyde has the highest relative citation impact (RCI) for its publications. Pintos, María from Universidad de Granada has published the maximum number of articles with 78 citations (Bhardwaj, 2017).

Research questions

Researchers intended to seek answers to the following specific research questions.

1. What is the frequency distribution of published articles in the field of Altmetrics based on the year, language, and type of publication?
2. What are the most productive countries, institutions, and authors publishing documents in Altmetrics?
3. What are the highly cited and top articles in the field of Altmetrics?
4. How are the Co-occurrence map of the most frequent keywords and Co-citation map of top and core journals and cited authors of articles in Altmetrics?

Materials and Methods

Selection of the research method depends on various criteria such as purpose, nature, facilities, etc. Since the present research aims were to determine the evolution of Altmetrics publications in the last 11 years, highly cited articles, top authors, countries and universities, and core journals in the field of Altmetrics, it was applied research conducted using bibliometric methods. The research data were collected and analyzed in September 2021. Considering many of the 2021 documents were not indexed in Scopus at the time of the study, and several journals delayed in publishing articles, the population of this study includes all documents indexed in the 11- year period from 2010 to 2020 in the field of Altmetrics in Scopus database. Since Altmetrics may mention in a singular form in some texts (Altmetric) and plural one in others (Altmetrics), we have used both keywords in the search strategy as follows:

(TITLE-ABS-KEY ("Altmetric") OR TITLE-ABS-KEY ("Altmetrics")) AND PUBYEAR > 2010 AND PUBYEAR < 2020

Using the above search strategy, 1077 documents indexed in Scopus in the field of Altmetrics were retrieved by the time of the search and these articles were analyzed. Bibliometrics indices presented in this study included year of publication, type and language of the documents, most cited articles, most productive authors, country, and institutional affiliation source / journal title in which documents were published.

Finally, data analysis was performed using Microsoft Excel and VOSviewer software. Microsoft Excel 2019 was run for bibliometric analysis and VOSviewer software for visualization and drawing scientific maps. VOSviewer software is one of the most important and widely used bibliometrics software that is used to summarize data and draw scientific maps. Using VOSviewer software, it is possible to draw scientific maps through techniques Citation analysis, Co-authorship analysis, Co-occurrence analysis, and Co-Citation Analysis.

Results

The frequency distribution of published documents in the field of Altmetrics based on the year, language, and type of publications

The publishing trend in the field of Altmetrics is shown in figure 1. As you can see in this diagram, 1077 documents have been published and indexed in Scopus by authors worldwide (2012 - 2020). Although the study period was from 2010, the first article on Altmetrics was published in 2012. According to figure 1, publishing in Altmetrics has risen from 12 records in 2012 to 229 in 2020. Moreover, more than 50% of the publications in this field have been published in the last three years (2018-2020). The first article indexed in Scopus on Altmetrics

entitled "*The new scholarly universe: Are we there yet?*" was Published in the *UKSG Journal* in March 2012 by Mike Taylor from the University of Wolverhampton in the UK. Three documents cite this article.

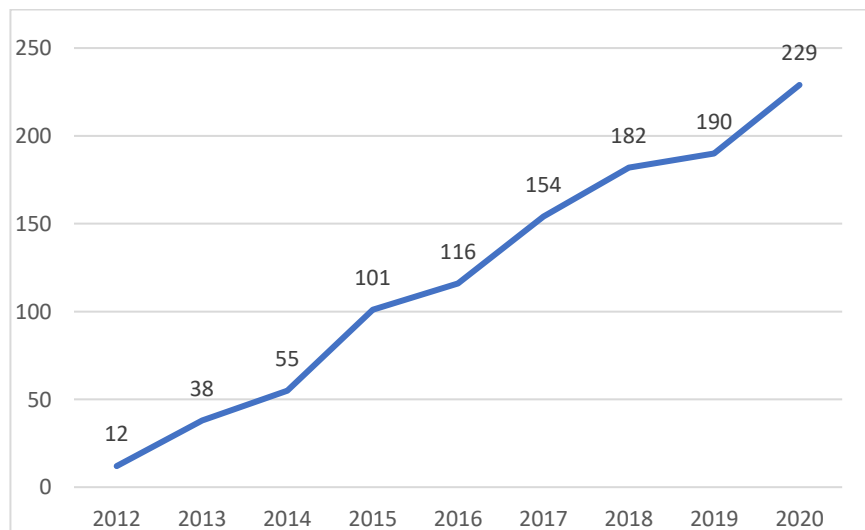


Figure 1: The publishing trend in the field of Altmetrics by year

The frequency of publications by language are shown in Table 1. As you can see in table 1, in total, the publications in the field of altmetrics have been published in 16 different languages that most of them (92.30%) are in English and indexed in Scopus database. Documents in Spanish (n=41) and Portuguese (n=22) ranked second and third, respectively.

Table 1

The frequency distribution of documents by the language of publications

Language of publications	Frequency	% Frequency
English	994	92.30%
Spanish	41	3.80%
Portuguese	22	2.04%
Persian	9	0.83%
German	6	0.55%
Italian	4	0.37%
French	3	0.27%
Russian	2	0.18%
Arabic	1	0.09%
Bosnian	1	0.09%
Chinese	1	0.09%
Croatian	1	0.09%
Dutch	1	0.09%
Hungarian	1	0.09%
Japanese	1	0.09%
Slovenian	1	0.09%

The frequency of documents by type of publication are shown in figure 2. As you can see, most of the publications were the type of article. In other words, from 1077 documents, 664

documents (64%) were articles. “Conference Paper” with 162 documents (15%) and “Review” with 78 documents (7.25 %) were in the second and third rank, respectively.

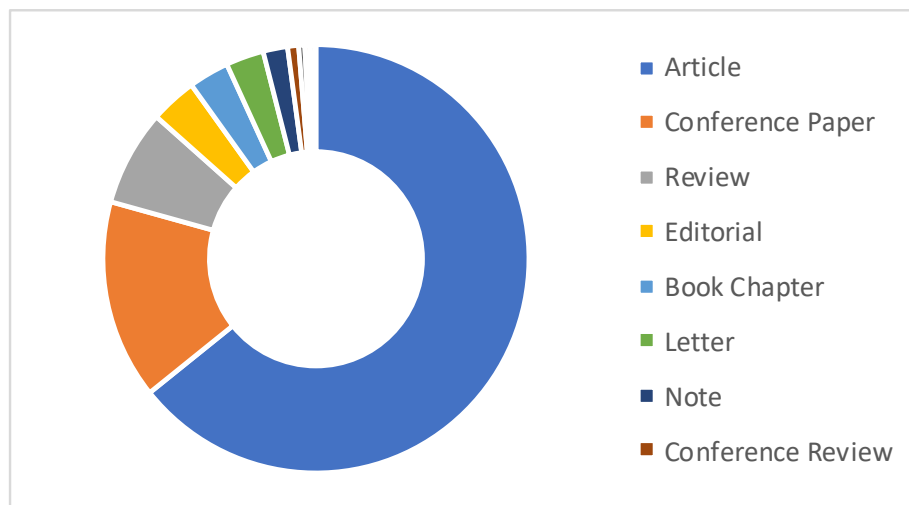


Figure 2: The frequency distribution of documents by the type of publications

Top countries in publishing scientific documents in the field of Altmetrics

In total, researchers from 64 countries have published documents in the field of Altmetrics since 2012. figure 3 presents the list of the top 20 countries that publish documents in the field of Altmetrics. The United States, with 282 documents (26.18 % of all publications), was the most productive country publishing documents in Altmetrics. The United Kingdom, with 163 documents (15.13%), and Spain, with 107 documents (9.93%), ranked second and third, respectively. 38% of the total publications in this field belong to these three countries. Iran, with 52 documents (4.82%), ranked ninth. It should be pointed out that the country's name was not mentioned in 29 documents.

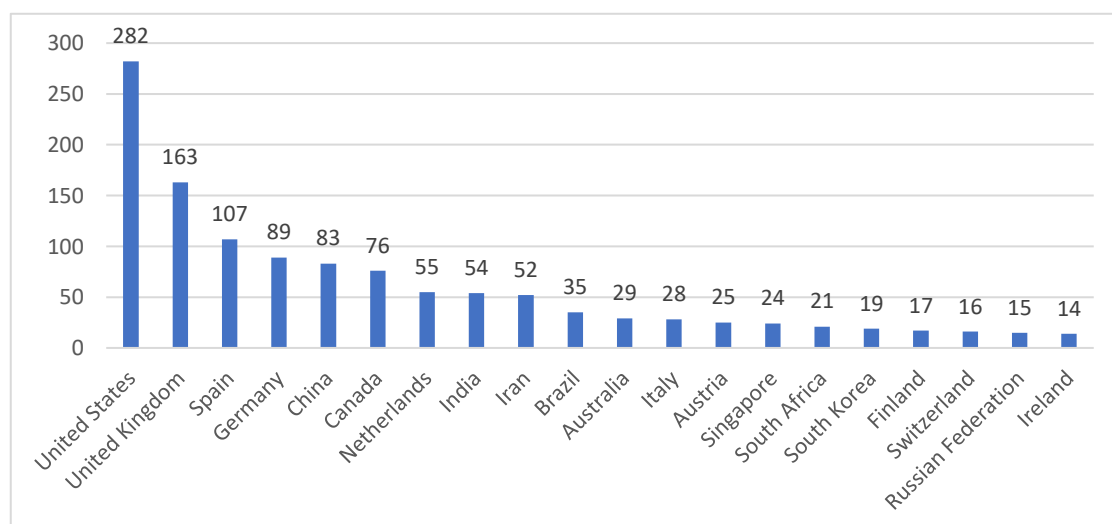


Figure 3: Productive and top countries in publishing documents in the field of Altmetrics

The most productive institutions in publishing documents in the field of Altmetrics

Overall, researchers from 160 universities and institutions worldwide have published

documents in Altmetrics. Table 2 presents information on 20 top and most productive universities and institutions in Altmetrics. The results show that the University of Wolverhampton, United Kingdom, with 45 documents and 2329 citations, is the most productive university publishing on Altmetrics and ranks first. Then the Administrative Headquarters of the Max Planck Society, Germany, ranks second in terms of the number of documents (with 32 documents), but in terms of the number of citations, with 975 citations, is in the fifth rank. Leiden University, Netherlands, ranks third in terms of the number of documents (27 documents) and the number of citations (1112 citations).

Table 2

Productive institutions in publishing documents in the field of Altmetrics

Rank by Document Count	Institute	Country	Documents count	Total citations	Rank by Total citations
1	University of Wolverhampton	United Kingdom	45	2319	1
2	Administrative Headquarters of the Max Planck Society	Germany	32	975	5
3	Leiden University	Netherlands	27	1112	3
3	Universidad de Granada	Spain	27	423	7
4	Max Planck Institute for Solid State Research	Germany	25	447	6
5	Nanyang Technological University	Singapore	23	232	14
6	University of Montreal	Canada	22	1683	2
6	Elsevier B.V.	Netherlands	22	209	15
7	Wuhan University	China	21	110	17
8	The University of North Carolina at Chapel Hill	United States	20	406	8
9	Consejo Superior de Investigaciones Científicas	Spain	19	323	9
9	Universitat Politècnica de València	Spain	19	295	12
10	Leibniz- Informationszentrum Wirtschaft	Germany	18	321	10
11	Indiana University Bloomington	United States	17	1106	4
11	Wee Kim Wee School of Communication and Information	Singapore	17	66	20
12	Christian-Albrechts-Universität zu Kiel	Germany	15	162	16
12	Universität Wien	Austria	15	276	13
13	Science Exchange	United States	14	95	18
13	Dalian University of Technology	China	14	313	11
14	Center for Open Science	United States	12	87	19

The most productive authors in the field of Altmetrics

Totally 158 authors from around the world have published documents in the field of Altmetrics. Table 3 presents information on 20 top and productive authors in the field of

Altmetrics.

Table 3

Productive authors in the field of Altmetrics

Rank	Author	Affiliation/country	Documents count	% Of total	Sum of Times Cited	Average citations per item	h-index
1	Thelwall, M.	University of Wolverhampton/United Kingdom	42	3.90%	2338	55.66	24
2	Bornmann, L.	Administrative Headquarters of the Max Planck Society/Germany	32	2.97%	975	30.46	16
3	Haunschild, R.	Max Planck Institute for Solid State Research/Germany	25	2.32%	447	17.88	12
4	Haustein, S.	University of Ottawa/Canada	23	2.13%	1703	74.04	14
5	Costas, R.	Stellenbosch University/South Africa	22	2.04%	1111	50.5	13
6	Peters, I.	Christian-Albrechts-Universität zu Kiel/Germany	20	1.85%	344	17.2	7
7	Gunn, W.	Elsevier B.V., Amsterdam/Netherlands	16	1.48%	104	6.5	6
8	Holmberg, K.	Turun yliopisto/Finland	15	1.39%	552	36.8	11
9	Errington, T.	Center for Open Science/United States	14	1.30%	95	6.78	6
9	Iorns, E.	Science Exchange/United States	14	1.30%	95	6.78	6
9	Lomax, J.	Science Exchange/United States	14	1.30%	95	6.78	6
9	Tan, F.	Science Exchange/United States	14	1.30%	95	6.78	6
10	Gorraiz, J.	Universität Wien/Austria	13	1.20%	264	20.3	8
11	Alhoori, H.	Northern Illinois University/United States	12	1.11%	71	5.9	4
11	Ortega, J.L.	CSIC-JA - Instituto de Estudios Sociales Avanzados (IESA)/ Spain	12	1.11%	342	28.5	9
11	Perfito, N.	Science Exchange/United States	12	1.11%	79	6.58	5
11	Torres-Salinas, D.	Universidad de Granada/Spain	12	1.11%	242	20.16	7
12	Bar-Ilan, J.	Bar-Ilan University/Israel	11	1.02%	247	22.45	5
12	Erdt, M.	Wee Kim Wee School of Communication and Information/Singapore	11	1.02%	169	15.36	5
12	Xu, S.	The University of North Carolina at Chapel Hill/United States	11	1.02%	83	7.54	3

As you can see in table 3, Thelwall, M. from the University of Wolverhampton, United Kingdom, with the publication of 42 documents (3.90% of total documents) in the field of Altmetrics, is the productive author in this field. The total number of citations of these documents in Scopus was 2338, and according to these citations, the author's h-index is 24,

which is the highest h-index among the authors. Bornmann, L. from the Administrative Headquarters of the Max Planck Society, Germany, with 32 documents (2.97% of total documents), was ranked second. The h-index of this author was 16 because of receiving 975 citations in his documents. Haunschild, R. from Max Planck Institute for Solid State Research, Germany, with 25 documents, 445 citations, and an h-index of 12 was ranked third.

The highly cited and top articles in the field of Altmetrics

The characteristics of 25 highly cited articles in the field of altmetrics are presented in Table 4. As you can see in table 4, the article "Do Altmetrics Work? Twitter and Ten Other Social Web Services" by Thelwall, M., with 545 citations in Scopus, is the most cited article in the field of altmetrics. This article was published in May 2013 in *PLoS ONE* and indexed in Scopus. The article by Costas, R & et al. entitled "Do altmetrics correlate with citations? Extensive comparison of altmetric indicators with citations from a multidisciplinary perspective" also came in second with 340 citations. This article was published on October 2015 in the *Journal of the Association for Information Science and Technology*. The article by Mingers, J and et al., entitled "The Review of Theory and Practice in Scientometrics" was ranked in third with 270 citations in Scopus. This article was published in October 2015 in the *European Journal of Operational Research*. Notably, the number of citations to the 25 given articles was very close. Also, from 25 highly cited articles, nine were published in *Scientometrics*, which was more than other journals.

Table 4

The characteristics of 25 highly cited articles in the field of altmetrics

Rank	Article Title	First Author	Year	Source title	Volume	Issue	Pages	Times cited
1	Does Altmetrics Work? Twitter and Ten Other Social Web Services	Thelwall M.	May 2013	PLoS ONE	8	5	N/A	545
2	Do "altmetrics" correlate with citations? Extensive comparison of altmetric indicators with citations from a multidisciplinary perspective	Costas, R.	October 2015	Journal of the Association for Information Science and Technology	66	10	2003-2019	340
3	A review of theory and practice in scientometrics	Mingers, J	October 2015	European Journal of Operational Research	246	1	1-19	270
4	Do altmetrics point to the broader impact of research? An overview of benefits and disadvantages of altmetrics	Bornmann L.	October 2014	Journal of Informetrics	8	4	895-903	237
5	Altmetrics: Value all research products	Piwowar, H.	January 2013	Nature	493	7431	159	223
6	How well developed are altmetrics? A cross-disciplinary analysis of the presence of 'alternative metrics' in scientific publications	Zahedi, Z.	October 2014	Scientometrics	101	2	1491-1513	211

Rank	Article Title	First Author	Year	Source title	Volume	Issue	Pages	Times cited
7	Scholarly use of social media and altmetrics: A review of the literature	Sugimoto, C.R.	September 2017	Journal of the Association for Information Science and Technology	68	9	2037-2062	184
8	Mendeley readership altmetrics for the social sciences and humanities: Research evaluation and knowledge flows	Mohammadi, E.	August 2014	Journal of the Association for Information Science and Technology	65	8	2627-1638	169
9	Characterizing social media metrics of scholarly papers: The effect of document properties and collaboration patterns	Haustein, S.	March 2015	PLoS ONE	10	3	N/A	168
10	Disciplinary differences in Twitter scholarly communication	Holmberg, K.	October 2014	Scientometrics	101	2	1027-1042	159
11	Coverage and adoption of altmetrics sources in the bibliometric community	Haustein, S.	October 2014	Scientometrics	101	2	1145-1163	157
12	Evaluating altmetrics	Sud, P.	February 2014	Scientometrics	98	2	1131-1143	155
13	The Altmetrics Collection	Priem, J.	November 2012	PLoS ONE	7	11	N/A	146
14	Using altmetrics for assessing research impact in the humanities	Hammarfelt, B.	October 2014	Scientometrics	101	2	1419-1430	133
15	Who reads research articles? An altmetrics analysis of Mendeley user categories	Mohammadi, E.	September 2015	Journal of the Association for Information Science and Technology	66	9	1832-1846	129
16	The altmetric score: A new measure for article-level dissemination and impact	Trueger, N.S.	November 2015	Annals of Emergency Medicine	66	5	549-553	116
17	Grand challenges in altmetrics: heterogeneity, data quality and dependencies	Haustein, S.	July 2016	Scientometrics	108	1	413-423	114
18	The open access advantage considering citation, article usage and social media attention	Wang, X.	May 2015	Scientometrics	103	2	555-564	113
19	Tweets as impact indicators: Examining the implications of automated “bot” accounts on Twitter	Haustein, S.	January 2016	Journal of the Association for Information Science and Technology	67	1	232-238	110
20	Altmetric: Enriching scholarly content with article-level discussion	Adie, E.	January 2013	Learned Publishing	26	1	11-17	108

Rank	Article Title	First Author	Year	Source title	Volume	Issue	Pages	Times cited
	and metrics							
21	Relationship between altmetric and bibliometric indicators across academic social sites: The case of CSIC's members	Ortega, J.L.	January 2015	Journal of Informetrics	9	1	39-49	107
22	Alternative metrics in scientometrics: A meta-analysis of research into three altmetrics	Bornmann, L.	June 2015	Scientometrics	103	3	1123-1144	104
23	Altmetrics: Rethinking the Way We Measure	Galligan, F.	March 2013	Serials Review	39	1	56-61	100
24	ResearchGate: An effective altmetric indicator for active researchers?	Yu, M.-C.	February 2016	Computers in Human Behavior	55	N/A	1001-1006	98
25	Do highly cited researchers successfully use the social web?	Mas-Bleda, A.	October 2014	Scientometrics	101	1	337-356	97

Co-occurrence map of most frequent keywords in the field of Altmetrics

The keywords are the essential concepts of scientific publications that reflect the text's content, so visualizing them will give us a good insight into the topics of articles published in the field of Altmetrics. By using VOSviewer software, a co-occurrence map of the most frequent keywords was drawn. For this purpose, 3826 author-used keywords were extracted from documents in the field of Altmetrics, and a co-occurrence map of 59 most frequent keywords that had been repeated 20 or more times in the documents was drawn. Figure 4 shows the co-occurrence map of the most frequent keywords. According to figure 4, the keywords "Altmetrics", "Social Media," and "Bibliometrics" are the most substantial keywords of the published documents in the field of Altmetrics. Also, these frequent keywords were located in three large clusters: the first cluster (red) consists keywords related to social media; the second cluster (green) mostly contains keywords related to journals; the third cluster (blue) mostly includes keywords related to articles.

Discussion

This study aimed at analyzing the scientific publications in the Altmetrics indexed in Scopus, using bibliometrics and scientometric methods. Scopus and Web of Science are the most important and reliable citation databases worldwide for Scientometric studies (Riahi, Siamian, Zare & Yaminfirooz, 2015). In Scientometric studies, only documents indexed in one database are analyzed. In the current study Scopus database was used. For this purpose, 1077 documents in the field of Altmetrics during the years 2010-2020 were retrieved and analyzed. The results show that the starting point for the publication of documents in Altmetrics' field was 2012; the publishing trend in this field has been improving and rising from 12 records in 2012 to 229 in 2020).

In comparison, the results of this study, in terms of upward trend, are consistent with many scientometrics researches in different topics (Hebebcı, 2021; Khasseh et al., 2021). However, the results are also contrary to some of the research results by Kumar and Sanjaya (2014), which examined the subject of documents in the field of Altmetrics indexed in Web of Science. In this research, the number of documents in this field decreased in 2014. The Altmetrics field is a relatively newly-emerged field that is still in its initial stages, so the upward trend in publications indicates that the Altmetrics field is developing and has a bright future. An increasing trend of research in altmetrics reflects the growing popularity among researchers over time, which reflects the increasing trend of annual publications in this field of research. On the other hand, more than 50% of publications in this field have been published in the last three years (2018 to 2020). Therefore, the highest number of documents is related to 2020 (N = 229). This finding is inversely related to the findings of some studies (Prashant Kumar, Subhranshu Bhushan, Sagar Bhimrao, Kanu, & Shiva Shankar, 2020; Kumar & Sanjaya, 2014). Their review in the middle of the year showed that the number of publications decreased in the last year. This increasing trend will continue as the field is newly-emerged and highly considered.

The results also show that, in total, the publications in the field of Altmetrics have been published in 16 different languages, and English and Article are, respectively, the predominant language and publication form of most documents. It is reasonable as English is a dominant scientific language worldwide, and original articles are highly-considered research publications in scientific journals. Senthilkumar (2020) also concluded in his study that Articles are the predominant type of publishing format.

The results show that authors from the United States have published 26.18 % of documents. So this country was the most productive in publishing in Altmetrics. The United Kingdom published 15.13% of documents, and Spain published 9.93% of documents, ranked as second and third, respectively. According to the results of some studies (Shonhe, 2020; Hebebcı, 2021; Kumar & Sanjaya, 2014), the United States is a productive country publishing documents in different topics. Considering that Iran's share in publishing documents in this field is 4.82% (ninth rank), it can be concluded that Iran is also an active country publishing in Altmetrics. Iran is a dynamic newly-emerged productive country in several fields, too.

The results of the study of institutions in terms of publishing in the field of Altmetrics show that the University of Wolverhampton, United Kingdom, both in terms of documents count (with 45 documents) and in terms of received citations (with 2329 citations), is the most productive institution in this field. This part of the results confirmed the results of the bibliometric studies of Kumar and Sanjaya (2014) and Baskaran (2020). The Administrative

Headquarters of the Max Planck Society, Germany, and Leiden University, Netherlands, are in the next ranks.

From the perspective of the top authors in the field of Altmetrics, the results show that Thelwall, M. from the University of Wolverhampton, United Kingdom, with the publication of 42 documents (3.90% of total documents) in the field of Altmetrics is the most productive author in this field. The total citation rate of these documents in Scopus was 2338 and according to these citations, the author's h-index is 24, which is the highest h-index among the authors. Thelwall, Mike, with 497 documents in computer science and social science, is one of the most influential Authors in the field of science and scientific communication. This author's article entitled "Do Altmetrics Work? Twitter and Ten Other Social Web Services," with 545 citations is the most cited articles in the field of Altmetrics. Thelwall is a highly-cited and influential author, so his documents have received 18764 citations by 10783 documents.

Also, out of 25 highly cited articles, nine were published in *Scientometrics*, more than other journals. Given the high level of journal of *Scientometrics* among researchers, this result seems quite logical. In addition, the altmetric and related topics fit well in this journal's scope.

According to the results, the keywords "Altmetrics", "Social Media" and "Bibliometrics" are the most frequent keywords of the published documents in the field of Altmetrics. These terms are co-related ones with interlinks. "Benchmarking", "Authorship" and "Algorithm" are the lowest frequent keywords in this field that these topics seem to have received less attention in Altmetrics studies.

Conclusion

According to this study, Altmetrics is still developing and will have a bright future. The last 8 years have seen different types of studies in almetrics, such as country-specific studies (Banshal, Singh, Muhuri & Mayr, 2019a, 2019b), almetrics in different disciplines (Banshal et al., 2019a; Tang, Liao & Su, 2018) and journal-level altmetric studies (Banshal, Singh, Kaderye, Muhuri, & Sánchez, 2018; Banshal, Singh, Muhuri & Mayr, 2019b; Barakat et al., 2018; Huang, Wang & Wu, 2018; Repiso, Castillo & Torres-Salinas, 2019). However, studying the bibliometrics of the almetrics was a knowledge gap firstly considered in this study. No strong indicators have yet been developed to measure the social impact of research. Researchers have extensively examined the relationship between citations and almetrics in various aspects of research publications. However, developing new indicators based on almetrics data has become a significant concern and related research needs to be strengthened.

This study has some practical implications. Using the research results, researchers interested in this field can better participate in scientific communications and conduct future research. Based on the results of this research, by identifying the countries, individuals and institutions that had most activity in this field, it is possible to encourage research and external study at the international level with other countries that are actually less active. Guidelines can be defined to enhance the effects of social research in the countries, individuals, organizations and publications extracted with the least amount received, which will strengthen and grow them in the coming years. Based on the results, it is also possible to examine growing and futuristic programs in the field of alternative factors such as Altmetrics. Identifying strengths and weaknesses and extracting current topics makes it possible to identify future research areas.

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Conflict of Interests

The authors declare that they have no conflict of interests.

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