

# Altmetrics Research Progress: A Bibliometric Analysis and Visualization

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## ABSTRACT

The present study explores the altmetrics research area through bibliometric analysis and visualization. For the investigation of research material Scopus database was chosen, to obtain the bibliographic data. The search in database resulted in 973 documents. The data was obtained in CSV file format and for the basic data processing excel was used whereas for the visualization network VOSviewer software was employed. The investigation revealed that around 30.34% documents have open access. The major document type was articles (65.05%), with journals (81.39%) as major sources for document and English (92.70%) as the dominant language for documents. The research also revealed that there has been a constant rise in the number of publications in the field since its inception and documents belong to different subject areas with social science leading the way. The major sources were *Scientometrics* (12.33%) and *Journal of Informetrics* (3.18%). Most productive authors were Mike Thelwall (41 documents), Lutz Bornmann (32 documents); most producing countries were USA (264 documents) United Kingdom (141 documents); and most producing organizations were University of Wolverhampton with 43 documents, Administrative Headquarters of the Max Planck Society with 32 documents. The visualization of author network revealed that collaborations between top authors are taking place but in a close knitted environment where one group of authors do not collaborate much with other group. The country collaboration network revealed that the top countries are extensively collaborating without any restrictions and developing countries like India, Pakistan are part of this collaboration network as well. The term map created out of the abstract and title information of research documents also revealed the trend of research in the altmetrics field.

**Keywords:** Altmetrics, Bibliometric Analysis, Scopus, VOSviewer, Research Progress.

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## INTRODUCTION

The term Altmetrics can be broken into “Alt” + “Metrics”. Alt is for alternative and metrics is for measurement.<sup>[1]</sup> Jason Priem, a doctoral student at the University of North Carolina–Chapel Hill, North Carolina, USA coined the new term in a series of metrics terms in September 2010 on Twitter. In order to assess the quality of a research publication the traditional metrics like Impact Factor (IF), *h*-index, etc. are citation dependent that restricts the view of impact<sup>[2]</sup> and takes an immense amount of time to receive a considerable number of citations.<sup>[3]</sup> Thus, these traditional metrics were deemed not enough after the advent of social media where a lot of research discussions

were taking place on research articles.<sup>[4]</sup> Thus, altmetrics was born out of this necessity. Altmetrics was intended to solve the debatable problem of the scientific and the social impact of research publications.<sup>[5]</sup> The primary objective of altmetrics was to quantify the interactions that were taking place on the web like tweeting about the articles, sharing on the various social media, blogging about articles, or bookmarking.<sup>[6,7]</sup> In the rise of altmetrics, two websites Altmetrics.org and Altmetric.com made an immense contribution. Altmetrics.org is credited for various apps like ImpactStory, ReaderMeter, ScienceCard, PLoS Impact Explorer, PaperCritic and Crowdometer;<sup>[4]</sup> whereas Altmetric.com a commercial website by nature has collaborated with prominent publishers to act as an open tool and data provider of qualitative and quantitative data that complements conventional, citation-based estimations.<sup>[4]</sup> For these websites, various social media platforms like Twitter, Facebook, YouTube, LinkedIn and reference managers like Mendeley are used as data sources.<sup>[7]</sup> Altmetrics has been categorized from different points of

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view, for instance; based on primary functions,<sup>[7]</sup> usage,<sup>[8]</sup> engagement,<sup>[9]</sup> and platform type.<sup>[10]</sup> The score for altmetric is calculated based on a set standard<sup>[11]</sup> and its representation is done as a donut.<sup>[11]</sup> Altmetrics as a whole has advantages from four aspects of scholarly publication; diversity of visibility, speed of data available for analysis, openness of methods to extract data for analysis and a far greater reach for the scholarly judgments.<sup>[12]</sup> However, some disadvantages are; it's not citation-based, vulnerable to data manipulation, deprived of conceptual frameworks,<sup>[4]</sup> theories and common definitions,<sup>[4]</sup> language biases<sup>[4]</sup> to name a few. But since its inception in 2010, researchers have been intrigued by this very concept and have performed a lot of work in the field of altmetrics, starting from; its history tracing,<sup>[13,14]</sup> overview and discussion,<sup>[4,15]</sup> research impact assessment,<sup>[16-18]</sup> advocating its importance,<sup>[19]</sup> its advantages and disadvantages,<sup>[20]</sup> correlation with traditional metrics,<sup>[21,22]</sup> evaluations,<sup>[3]</sup> importance on journal websites,<sup>[23]</sup> effect of different disciplines on altmetrics attention score<sup>[24]</sup> etc. The use of altmetrics as a tool in various subject areas is a new direction of research and this has been reaffirmed in the current study. A time-line related to altmetrics has also been provided below which shows the development of the research field.

## LITERATURE REVIEW

Erdt *et al.*<sup>[25]</sup> carried out a research to provide a holistic view of altmetrics research by conducting a systematic review, correlation study between altmetrics, citation counts and comparison of tool features, data sources, provided by altmetric aggregators. Bornmann<sup>[26]</sup> carried out research into three of the most important altmetrics: microblogging (Twitter), online reference managers (Mendeley and CiteULike) and blogging where the work focussed on the correlation between altmetrics counts and citation counts. On similar lines Sugimoto *et al.*<sup>[27]</sup> performed an extensive review in scholarly utilization of social media and altmetrics. Solanki<sup>[28]</sup> analysed the social media coverage of the research productivity of 100 most productive Indian Institution whereas Banshal *et al.*<sup>[29]</sup> Studied the extent of social media attention of articles from India on different platforms and their similarities/differences worldwide. Banshal *et al.*<sup>[30]</sup> also conducted an exploratory analysis of importance of altmetrics data through a case study of scholarly articles from India published during 2016 and indexed in Web of Science and updated on ResearchGate. These literatures tried to study the growth of altmetrics as subject through various perspectives over the years. The provided time-line and the wider spectrum of altmetrics research discussed in the previous and in this section concrete the fact that literature on altmetrics is growing day by day. Thus, to study this immense amount of literature on altmetrics, a well-known tool termed as bibliometrics<sup>[31]</sup> has been applied. The bibliometric analysis estimates the impact

of research by making use of the quantitative indicators.<sup>[32]</sup> The analysis generally results in the acquisition of important information providing a holistic view of the research.<sup>[33]</sup> There have been previous attempts to study the altmetrics literature<sup>[34-36]</sup> using a few bibliometric indicators. In the literature review, few studies using bibliometrics have also been performed on bibliometrics itself,<sup>[37]</sup> scientometrics and informetrics.<sup>[38]</sup>

The present work focuses on the research progress of altmetrics research since its inception through a bibliometric analysis and visualization. Though the literature reveals that there exist few works where scientometric analysis and bibliometric analysis of altmetrics research has been performed but it was during the earlier stages of the field introduction where the number of publication output were quite less as compared to this study. This study will express the research growth of the subject since its inception from 2010 to 2020 which is quite a long time-span to see the growth of the subject.

## Objective of the study

- To explore the documents published in the field of altmetrics from access type, document type, source type and language perspective.
- To explore the trend of publications since its inception from 2010 and the dominant subject area contributions for documents.
- To locate the core pioneers in the field of altmetrics from researcher's, countries, organization's and funding agency's standpoint and also identify the most cited articles in the field.
- To study the collaboration pattern based on author and country through visualization.
- To study the term map visualization based on the textual data to detect patterns of research.

## DATA AND METHODOLOGY

To conduct this bibliometric study on altmetrics, Scopus (<https://www.scopus.com/home.uri>) as a data source was used for obtaining the bibliographic data. The search string used for obtaining the bibliographic data was (TITLE-ABS-KEY ("Altmetri\*")). This allowed identifying and returning all the documents that contained terms like "Altmetric" or "Altmetrics" in their title, abstracts, or keywords (both author and indexed keywords). Since the search was not restricted to any time-span it returned the document records from the field since its inception. The search was carried on 12<sup>th</sup> August 2020. The database search resulted in obtaining the bibliographic data of 973 records. Scopus database facilitates data in different data formats. For this analysis, the data was extracted in CSV file

format. The basic data processing work was carried out using the CSV file formats and tables, graphs were generated out of the processed data using Microsoft Excel. For developing the network visualization maps from the data, a freely available software VOSviewer<sup>[39]</sup> was used. The data was loaded in the software in the same CSV file format and various visualization maps were obtained to analyse the various patterns of research

**Table 1: Summary of scientific publications on altmetric from SCOPUS database.**

Data Summary	Findings
Total documents	973
Total authors	1942
Total organizations	1818
Total sources	389
Total countries	81
Total citations	10112
Total cited documents	686
Total cited references	27242
Total cited sources	10217
Total cited authors	25275
All keywords	3443
Average citations	10.39
Average authors	1.99
Average organizations	1.86

from different dimensions. A bibliographic data summary has been provided below in Table 1.

## RESULTS

### Document Analysis

In order to present the document analysis, the document level statistical data was obtained. This particular data gave an overview of the document records that were used for analysis. The document analysis was conducted at four levels namely: access type; document type, source type and document language. A total of 973 document records were obtained out of which a considerable number of document records (30.94%) were open access and still a large number of document records (69.06%) had other access types. This particular data was encouraging as this depicts that a significant amount of research material in altmetrics are openly available for the study. As for document type, the majority of the documents were found to be articles (65.05%) and conference papers (15.93%) followed by reviews (6.78%). The rest of the document type's editorials, letters, notes, etc. were quite less. The primary source for documents was found to be journals (81.39%) and conference proceedings (13.56%) followed by book series (3.49 %). Moreover, the

maximum literature on altmetrics was produced in the English language (92.70%) followed by Spanish (3.59%). These facts strengthen that, journals are still the go-to material for researchers for publications and English is the most used language for communication of scientific literature. Table 2 depicts the document language distribution, Table 3 depicts the distribution of document types, Table 4 depicts the source type distribution and Table 5 depicts the document language type distribution.

### Trend of publications

To study the publication trend of documents, a bar-graph has been created with the help of excel. The total number of documents was distributed over nine years from 2012 to 2020. The first literature on altmetrics was supposedly indexed in the year of 2012 according to Scopus data. Since then there has been a significant and steady increase in the number of publications. The highest publications (191) were in 2019. The data suggests that the field has been on a constant rise over the years barring a dip that is depicted in Figure 1 from

**Table 2: Document access type distribution.**

Access Type	Number of Documents	Percentage of Documents
Open Access	301	30.94
Others	672	69.06

**Table 3: Document type distribution.**

Document type	Number of Documents	Percentage of Documents
Article	633	65.05
Conference Paper	155	15.93
Review	66	6.78
Editorial	36	3.69
Letter	27	2.77
Note	18	1.84
Book Chapter	16	1.64
Conference Review	9	0.92
Book, Erratum, Short Survey	4	0.41
Undefined	1	0.10

**Table 4: Source type distribution.**

Source type	Number of Documents	Percentage of Documents
Journal	792	81.39
Conference Proceeding	132	13.56
Book Series	34	3.49
Book	12	1.23
Trade Journal	3	0.30

2019 to 2020. The reason could be that this study was carried out in the mid of 2020 and many days are left in the year. However, if the past trend is followed it can be assumed that the number of publications will be more than 2019 by the end of 2020.

### Subject area distributions

The total documents were spread over 27 subject areas according to the Scopus bibliographic data. This particular data affirms the usage of altmetrics as a tool to perform research in various disciplines. One particular document can fall into more than one subject area. The top six subject areas under which the documents have been categorized are depicted in Table 6. These top six subject areas show the diversity of subjects for the documents. The diverse subject areas also depict how the research community has become aware of altmetrics and are using it extensively for their research. Among these subject

areas, the maximum documents were from Social Sciences with 506 documents whereas the second most dominant area was Computer Science with 455 documents.

### Core authors of altmetrics

A total of 1942 authors contributed to the 973 documents. Among these, 159 authors had contributed more than one document. These multiple contributions show that many authors are working extensively in the field and publishing too. Table 7a depicts the six most productive authors in the field of altmetrics research. The list was topped by Mike

**Table 5: Document language distribution.**

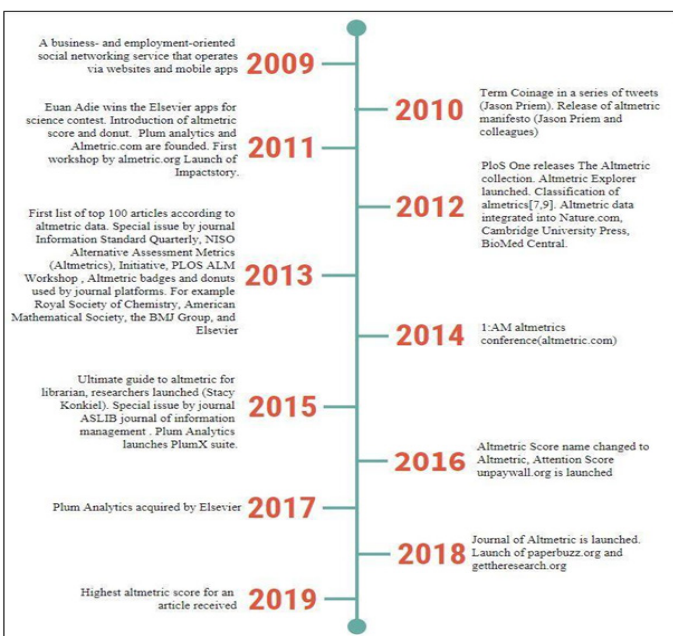
Document language	Number of Documents	Percentage of Documents
English	902	92.70
Spanish	35	3.59
Portuguese	16	1.64
Persian	8	0.82
German	6	0.61
French, Italian	4	0.41
Russian	2	0.20
Arabic, Japanese, Bosnian, Chinese, Croatian, Dutch, Hungarian	1	0.10

**Table 6: Most dominant subject areas for altmetrics research.**

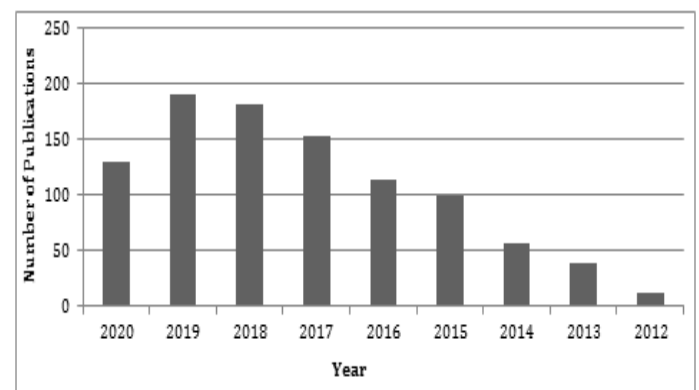
Document type	Number of Documents
Social Sciences	506
Computer Science	455
Medicine	184
Decision Sciences	99
Mathematics	91
Biochemistry, Genetics and Molecular Biology	64

**Table 7a: Most Productive Author.**

Name (Organization)	Number of Documents	Percentage of Documents
Mike Thelwall (University of Wolverhampton)	41	4.21
Lutz Bornmann (Division for Science and Innovation Studies, Administrative Headquarters of the Max Planck Society)	32	3.28
Robin Haunschild (Max Planck Institute for Solid State Research)	24	2.46
Stefanie Haustein (University of Ottawa)	22	2.26
Rodrigo Costas (Leiden University)	20	2.05
Isabella Peters Christian-(Albrechts-University Kiel)	18	1.84



**Figure 1: Time-line of Altmetrics Research.**



**Figure 2: Trend of publications.**

The wall with 41 documents to his name followed by Lutz Bornmann with 32 documents and Robin Haunschild with 24 documents. Among the top six authors, two were from Max Planck Institute (Germany).

### Core sources in altmetrics

A total of 389 sources were obtained which had published the literature from the field of altmetrics according to the Scopus data. Among these, 130 sources had published more than one document in them related to altmetrics. These sources consisted of all types like journals, conference proceedings, etc. The top six sources that published the maximum number of documents are depicted in Table 8a. The top sources for altmetrics articles were *Scientometrics* with 120 documents (12.33%) i.e. around 12 documents at a yearly average since the topic's introductions and *Journal of Informetrics* with 31 documents (3.18%). It was observed that since the topic is fairly new, some top conference proceedings have more or equal number of documents as compared to journals. The 17<sup>th</sup> *International Conference on Scientometrics and Informetrics* (26 documents, 2.67%) had more documents than journals like *Professional De La Informacion* (2.05), *PLoS One* (1.95%) and the 16<sup>th</sup> *International Conference on Scientometrics and Informetrics* (18 Publications, 1.84%), *Proceedings of the Association for*

*Information Science and Technology* (18 documents, 1.84%) had documents equal to the *Journal of the Association for Information Science and Technology*.

### Top countries in altmetrics research

It was observed that 81 countries contributed 973 documents towards the altmetrics field and 47 countries had multiple publications to their credit. The majority of contributions came from USA with 264 documents (27.13%), followed by United Kingdom with 151 documents (15.51%) and Spain with 98 documents (10.07%). A list of the top six countries according to the number of document contributions has been depicted in Table 7b. Countries that were found to be having the same number of publications were given the same position in the table.

### Core Organizations in altmetrics research

A total of 1818 organizations are credited with the 973 documents in altmetrics of which 160 organizations had at least three or more than three documents to their credit. The majority of contributions came from University of Wolverhampton (United Kingdom) with 43 documents (4.41%), followed by Administrative Headquarters of the Max Planck Society (Germany) with 32 documents (3.28%) and Leiden University (Netherlands) and Universidad de Granada (Spain) with 25 documents (2.56%) each. A list of top six organizations according to the number of document contributions has been depicted in Table 8b. The organizations that were found to be having the same number of documents were given the same position in the Table. The organizations associated with the European continent were the major players and among the top six organizations, Germany and Netherlands associated organizations occurred twice.

**Table 7b: Top countries for altmetrics research.**

Country	Number of Documents	Percentage of Documents
USA	264	27.13
United Kingdom	151	15.51
Spain	98	10.07
Germany	77	7.91
Canada, China	74	7.60
Netherlands	53	5.44

**Table 8a: Core Sources for altmetrics.**

Source Title	Number of Documents	Percentage of Documents
<i>Scientometrics</i>	120	12.33
<i>Journal Of Informetrics</i>	31	3.18
17th International Conference On Scientometrics And Informetrics 2019 Proceedings	26	2.67
<i>Professional De La Informacion</i>	20	2.05
<i>PLoS One</i>	19	1.95
16th International Conference On Scientometrics And Informetrics Conference Proceedings, Proceedings Of The Association For Information Science and Technology, Journal Of The Association For Information Science And Technology	18	1.84

**Table 8b: Top organizations for altmetrics research.**

Organizations	Number of Documents	Percentage of Documents
University of Wolverhampton (United Kingdom)	43	4.41
Administrative Headquarters of the Max Planck Society (Germany)	32	3.28
Leiden University(Netherlands), Universidad de Granada (Spain)	25	2.56
Max Planck Institute for Solid State Research (Germany)	24	2.46
Elsevier B.V.(Netherlands)	22	2.26
Nanyang Technological University (Singapore), University of Montreal (Canada)	21	2.15

## Top funding agencies for altmetrics research

A lot of funding organizations were found to be providing funds for supporting altmetrics research. Around 50 agencies had more than one document associated with it. Among these 50 agencies, the top six funding agencies have been listed in Table 9. Agencies that were found to have the same number of publications were given the same position in the table. The top funding agencies were the National Natural Science Foundation of China (China) with 21 documents followed by Fundamental Research Funds for the Central Universities (China) with 13 documents and Alfred P. Sloan Foundation (USA) and National Science Foundation (USA) with 12 documents each. Among these top funding agencies, it was observed that the majority of them belonged to China, USA, Europe and Canada.

## Top cited documents in altmetrics

According to the Scopus database among the 973 documents that were in the study 686 had received citations i.e. 70.05% documents. Among these documents, the top six documents that received maximum citations are listed below in Table 10. The top-cited documents were “Do Altmetrics work? Twitter and ten other social web services” with 472 citations and “Extensive comparison of altmetric indicators with citations from a multidisciplinary perspective” with 276 citations. In these top six cited documents authors Zohreh Zahedi (Leiden University) Rodrigo Costas (Leiden University) and Paul Wouters (Leiden University) have together co-authored two documents and received high citations.

## Collaboration analysis

Scientific collaboration is the new norm for research.<sup>[40]</sup> It basically allows researchers to exchange ideas, create new

ones and reduce the workload as well. Generally, it is expected that collaborations will result in a greater number of quality publications for authors exploring the new facets of the topics.<sup>[41,42]</sup> The impact of collaborations on various subjects like forensic science,<sup>[43]</sup> rice crops<sup>[44]</sup> were studied to reveal the collaboration pattern. Hence an analysis based on the collaboration of authors, countries was performed with the help of VOSviewer software. For this work, a full counting method was employed that resulted in each co-occurrence link having equal weight age. For normalization of the co-occurrence matrix, various standards are provided in the VOSviewer, although here the association strength method was used. The resolution parameter for cluster development was kept at 1.00. For the network visualization map, a node was represented by a circle that represents the author, country, or organization in case of collaboration analysis. The size of the circle depicts the number of documents and the links between the circles represent the collaborative relationship between authors and countries. The width of the links represents the power of collaboration, the adjoining circles are deemed to represent the proximity of collaborations. The total linkage power of a node is the aggregation of all linkage powers of the particular node over all nodes.<sup>[39,45]</sup>

## Author based

The total number of authors credited for the 973 documents was 1942. For the development of the bibliometric visualization, the minimum number of documents for an author was kept at 10 and the number of citations received was kept at 1. On applying the criteria, 24 authors were shortlisted. The total power of the collaboration links for

**Table 9: Top Funding Agencies for altmetrics research.**

Funding Agencies	Number of Documents	Percentage of documents
National Natural Science Foundation of China (China)	21	2.15
Fundamental Research Funds for the Central Universities (China)	13	1.33
Alfred P. Sloan Foundation (USA), National Science Foundation (USA)	12	1.23
National Institutes of Health (USA)	10	1.02
European Commission (Europe), National Research Foundation Singapore (Singapore)	6	0.61
European Regional Development Fund (Europe), Horizon 2020 Framework Programme (Europe Union), Social Sciences and Humanities Research Council of Canada (Canada), China Scholarship Council (Canada), Canadian Institutes of Health Research (Canada)	5	0.51

**Table 10: Top cited documents in altmetrics research.**

Publication Title	Times Cited, SCOPUS
Thelwall M, Haustein S, Larivière V and Sugimoto C R, Do altmetrics work? Twitter and ten other social web services, <i>PloS one</i> , 8 (5) (2013), e64841.	472
Costas R, Zahedi Z and Wouters P, Do “altmetrics” correlate with citations? Extensive comparison of altmetric indicators with citations from a multidisciplinary perspective, <i>Journal of the Association for Information Science and Technology</i> , 66 (10) (2015), 2003-2019.	276
Piwowar H, Value all research products, <i>Nature</i> , 493 (7431) (2013), 159-159.	203
Bornmann L, Do altmetrics point to the broader impact of research? An overview of benefits and disadvantages of altmetrics, <i>Journal of Informetrics</i> , 8 (4) (2014), 895-903.	182
Mingers J and Leydesdorff L, A review of theory and practice in scientometrics, <i>European Journal of Operational Research</i> , 246 (1) (2015), 1-19.	180
Zahedi Z, Costas R and Wouters P, How well developed are altmetrics? A cross-disciplinary analysis of the presence of ‘alternative metrics’ in scientific publications. <i>Scientometrics</i> , 101(2) (2014), 1491-1513.	179

these 24 authors was calculated. Authors with the greatest collaboration links were selected. The 24 authors were segregated in eight clusters. Among these, only three clusters had single authors. This depicts that authors are having multiple publications and are highly collaborating. All these authors of each of the eight clusters have been represented by different colors to show the segregation. It was observed that only two clusters had authors connected to each other. This means that though there are clusters that have more than one authors but they have a close-knitted relationship i.e. they are collaborating within the defined group as seen in Figure 2. The largest cluster comprised 10 authors (red color), the second largest cluster only had 5 authors (green color) and the rest three clusters had 2 authors each (blue, yellow and purple color). There are 36 links and the total link power is 242.

### Country based

A total of 81 countries are credited for the 973 documents. For the development of the bibliometric visualization, the minimum number of documents for a country was kept at 10 and the citations received were kept at 1. On applying the criteria 26 countries were shortlisted. For these 26 countries, the total power of the collaboration links was calculated. Countries with the greatest collaboration links were selected. The total 26 countries were segregated in five clusters and each cluster had multiple countries. Countries belonging to different clusters having multiple documents are collaborating as depicted by Figure 3. This means that there are no close-knitted relationships between the countries and rather global collaborations are taking place. It was good to observe that countries like India and Pakistan which are developing

countries were part of this global collaboration, showing the emergence, awareness and realization of the importance of altmetrics research. All these countries of each of the five clusters have been represented by different colours to depict the division. There are 102 links and the total link power is 353.

### Term map creation

The title and abstracts are considered as one of the most important components of the research paper. It not only reveals the thought process of each document but also provides a roadmap for understanding the trend of topics for publications in a particular area of research, the topics that are being emphasized and the upcoming topics. For the purpose of this study, a term map based on the co-occurrence of terms in title and abstract of the documents was created with the help of VOSviewer software which has a text-mining facility. The steps used in text-mining and visualization are; noun phrase identification, relevant noun phrase selection, clustering and mapping of terms based on an algorithm and visualization.<sup>[46]</sup> Figure 4 depicts the network map of all keywords. At first,

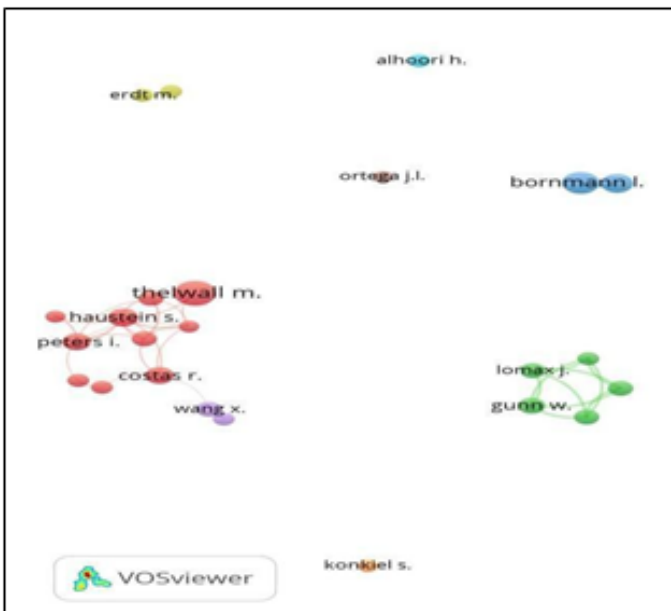


Figure 2: Network visualization map of author collaboration for top authors in altmetric research.

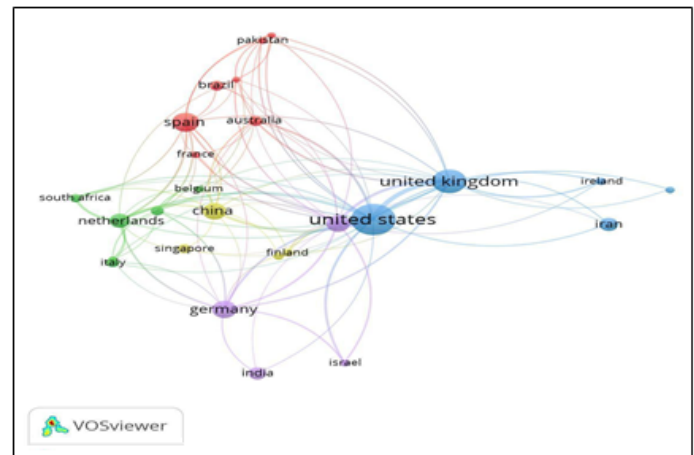


Figure 3: Network visualization map of country collaboration in altmetric research.

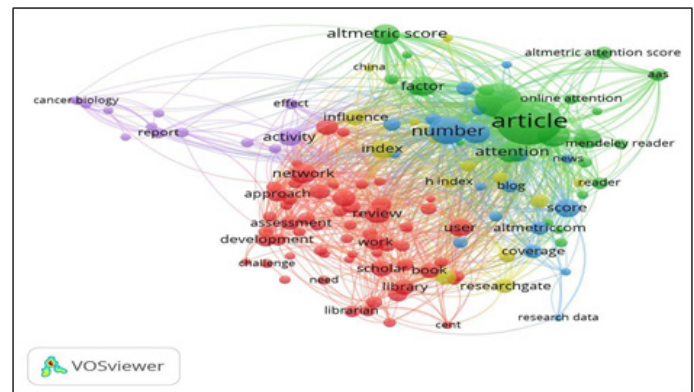


Figure 4: Term visualization map for most co-occurring terms in abstracts and title of the documents.

the abstract and title fields were loaded into the VOSviewer software. The full counting method was employed i.e. all the occurrences of the terms were counted.<sup>[47]</sup> This resulted in a total of 14672 terms from 973 documents. For the bibliometric mapping, the number of terms was reduced by keeping the minimum number of occurrences of a term to be 30. This resulted in a selection of 217 relevant terms. For each of the 217 terms, a relevance score was calculated.<sup>[48]</sup> This score facilitated the selection of the most relevant terms among these 217 terms and the default value of 60% of the most relevant terms, in this case 130 terms were used to create the term map. The size of each circle shows the number of occurrences of each term and links between the circles show the relationship of terms. The width of the links depicts the power of terms based on co-occurrence and the color of terms is determined by the cluster to which they belong. The most occurring term was article (1357), followed by journal (690), number (462), correlation (324) and altmetric score (250). These top occurrences of terms clearly depict that the field is related to the articles level metrics and still a lot of research is being carried out in determining its relationship with tradition metrics. There are five clusters, the largest cluster has 60 terms (red color) related to more general terms of the altmetric field like assessment, development, scholar, review, approach, etc. The second largest cluster has 24 terms (green color) related to the core studies of altmetrics like correlation of altmetrics and citation counts, attention received for articles and journals. The third largest cluster with 19 terms (blue color) deals with social media sources from which data are drawn for altmetrics. The fourth cluster with 14 terms (yellow colour) concentrated more on the database, countries and article indicators whereas the fifth cluster (purple colour) depicts research collaboration activities. There are 6917 links and the total link power is 120862.

## DISCUSSION

Altmetrics is the new and emerging research field of study where many dimensions of research are being explored. A timeline based on the literature of altmetrics has been provided in this study. The present study explored the field of altmetrics through bibliometric analysis by obtaining the bibliographic data from the Scopus database of 973 documents which has almost double the documents covered by Baskaran,<sup>[35]</sup> Senthilkumar<sup>[36]</sup> though the database is kept same but the time span of the study has been increased. A data summary was provided for the obtained bibliographic items and this has not been provided in previous works by Das and Mishra,<sup>[34]</sup> Baskaran<sup>[35]</sup> and Senthilkumar.<sup>[36]</sup> The study revealed that in the field of altmetrics a lot of documents (30.94%) have open access privileges which indicate that the visibility of such documents will be more and thus researchers will be encouraged. A majority of the documents i.e. 633 (65.05%)

documents were articles, the leading language for documents was English (92.09%) and source type for the documents were journals (81.39%). This particular information about the data items on access type privileges, type of documents and language of documents are missing in Das and Mishra<sup>[34]</sup> and Baskaran.<sup>[35]</sup> Senthilkumar<sup>[36]</sup> also concluded that journal articles were dominant document type. The document publication trend revealed that there has been a constant rise in the number of documents related to altmetrics. The highest number of documents (191 documents) was published in the year 2019 and the greatest leap was from 2014 to 2015 where the documents increased by 1.8 times. The dip in the year 2020 can be ascertained to the fact that the study has been carried out in the mid of 2020. The trend is similar to Das and Mishra.<sup>[34]</sup> The dominating subject area for the documents was found to be social sciences and computer sciences among the 27 subject areas that were linked to the documents which was similar to the work Senthilkumar.<sup>[36]</sup> Among the top authors, Mike Thelwall led the way similar to Das and Mishra,<sup>[34]</sup> however, two of the top authors were from different departments of the same institute (Max Planck) depicting it as a hub for research pertaining to altmetrics. The present work found that *Scientometrics* (12.33%) similar to the work of Senthilkumar<sup>[36]</sup> and *Journal of Informetrics* (3.18%) were the core sources for altmetrics research documents even though *PLoS one* has an Altmetrics Collection which was launched in the year 2012. In 2018 *Journal of Altmetrics* has been launched and is expected to have more publications in time. USA (27.13%) had most publications in the field similar to the work Senthilkumar,<sup>[36]</sup> Das and Mishra<sup>[34]</sup> followed by United Kingdom (15.51%), Spain (10.07%) and Germany (7.91%). However, in the case of organizations, University of Wolverhampton (United Kingdom, with 4.41%) similar to Das and Mishra;<sup>[34]</sup> Baskaran<sup>[35]</sup> work, followed by Administrative Headquarters of the Max Planck Society (Germany with 3.28%), Leiden University (Netherlands with 2.56%), Universidad de Granada (Spain with 2.56%) were at the top, though the USA has a lot more documents, the research is scattered in USA, wherein totality European countries are contributing towards the altmetrics research a lot. But when the funding agency data was analyzed it was observed that funding agencies from China viz. *National Natural Science Foundation of China* (2.15%), Fundamental Research Funds for the Central Universities (1.33%) and from USA *Alfred P. Sloan Foundation*, *National Science Foundation* (1.23%) and National Institutes of Health (0.61%) are funding more research than European Commission (0.51%). This particular data item about the funding agencies were missing in Das and Mishra;<sup>[34]</sup> Baskaran<sup>[35]</sup> and Senthilkumar.<sup>[36]</sup> This suggest than in Europe the research on altmetrics are being carried a lot but by independent researchers. Few of the top cited articles have been enlisted in this work. These articles though they



are not very old but have received high number of citations, this means that researchers are quite intrigued by previous works in the field and are using them to carry the research forward. The collaboration analysis through visualization revealed that author collaboration in authors are taking place but it takes place within a particular group of authors only and various groups of authors are not collaborating with other groups. But country collaboration revealed that the top countries in altmetrics research are collaborating and even developing countries like India, Pakistan are involved in these collaborations depicting the growing research reach of the altmetrics. A term map has also been generated to see the preliminary research trend of altmetrics. The abstract and title text data was loaded in VOSviewer and a term co-occurrence map was generated. This revealed that article level metrics are being studied extensively in the field and there is also trend of studying the correlation between the altmetrics data and traditional metric data to increase the concreteness of the field which has been concreted through the works of Erdt *et al.*<sup>[25]</sup> Bornmann;<sup>[26]</sup> Banshal *et al.*<sup>[29]</sup> and Banshal *et al.*<sup>[30]</sup> These type of visualization analysis are completely missing from previous works on altmetrics by Das and Mishra,<sup>[34]</sup> Baskaran<sup>[35]</sup> and Senthilkumar.<sup>[36]</sup>

## CONCLUSION

It has been observed that research community are quite social media aware and hence the use of altmetrics has been on the rise. The present work concretes the fact that the number of publications in altmetrics are on the rise and the study of altmetrics are being conducted from various perspectives to show its importance. A time-line of the major events in the field of altmetrics has been provided in this work and one of the major events of this timeline was establishment of *Journal of altmetrics* in 2018 which clearly suggests that in coming years we can expect more and more papers in the field. The researchers have been quite intrigued by the correlation of citation counts and altmetrics attention score and have been extensively conducting research on them. Even country wise assessment of altmetrics score of papers has gained popularity and research has been going on. Though the research is on the rise but very few of the researchers are extensively involved and those who are involved contribute with significant number of publications. Hence we need to encourage new researchers and of different discipline to work more in the field to have a wider spectrum of research.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## ABBREVIATIONS

CSV: Comma Separated File; USA: United States of America.

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