Correlation of Social Media Metrics and Citations:
A Case of Physical Review Letters

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Abstract

Scholarly literature is increasingly shared and discussed through the social web by researchers and academicians. The objective of the study is to investigate and measure the relationship of the citations with Altmetric Attention Score (AAS) for the selected articles in the physical review letter journal. Data extracted from Altmetric.com, Google Metrics, and from PlumXmetrics. Spearman correlation method was used to find the correlation between the Dimension and Scopus citations with AAS for selected articles, results show that the "p-value" stood as .009 and .002 which comes less than the significant level shows that high cited papers have a high AAS and the value of r stood as .772 and .851 which shows a high positive correlation between citations and AAS. US and Japan hold the top position countries with 816 and 326 tweets respectively. Mendeley and Twitter are contributing more to altmetrics scores. It is suggested that the Indian research community should also look forward to utilizing the social media platforms effectively to attract more audiences.

Introduction:

Social Media is increasing its popularity in scientific communication, academic social networking sites personalized specifically for the academic community to share their thoughts and promote their work. Mentions on the Internet and social media about the research articles open up new opportunities in the evaluation of research impact. Altmetrics

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provides the prospects of promotion to the entire academic and research community to proactively use social platforms to upsurge the value of research. The rise of the web and social platforms and their interest by the researchers have led to the formation of social media metrics for scholarly publications[1]. To analyse the research influence of academic publications, altmetrics is being widely used in recent years. Altmetrics is the method and the major parameter to measure the research impact on social media like Facebook, Twitter, Blog Mentions, Captures, etc. There are tools and techniques to analyse the social media visibility of the research articles. Altmetric.com, PlumXmetrics, and Crossref. Event Data are the major altmetric data providers. Altmetrics tools will collect the data from Blog Mentions, Twitter, Facebook, News articles, Presentations, Data Uploads, and shared citations[2].

Review of Literature:

Traditionally, research visibility and its impact have been measured by citations from the number of publications in the scholarly literature, and establishing web occurrences in a variety of social networks has increased the visibility of scholars on the Internet[3]. Research has intensified in the scholarly usage of social networking platforms and the development of innovative indicators constructed on social media interactions are formulated and subsequent promotion of altmetrics and research metrics based on social media activities[4]. Publications published in journals with high citations have more altmetric scores and are most possible to be shared on social platforms[5].The total views on social platforms like Twitter and Mendeley and the number of Scopus citations are having a positive relationship and social platforms can serve as an indicator of the number of citations[6].

Scholarly conversations and activities on social media may convey the research impact or visibility and these possibilities can be examined with altmetrics[7]. The usage of social platforms in research is a quite new phenomenon, as the technologies have grown in popularity among academics who see it as a way to not only enhance their links but also to share their discoveries[8]. At the same time, altmetrics requires more reflection, detailed analysis, and discussion about theoretical foundations[9]. Articles with the question have a limited social media presence, Twitter and Mendeley have the most association with citations, and the number of News outlets, Mendeley readers, and citations all has a high association[10]. Ortega[11] analyse the relationship between the influence of Twitter on the impact of research and the distribution of research articles on Twitter and the results found that the journals with Twitter accounts were able to obtain more Twitter mentions and citations. Open access documents will have more visible and there will be a possibility to get more citations and downloads, social tools must be taken into account to reach and increase a larger scholarly audience with the social impact[12].

Altmetrics as a new field is rapidly changing the incentives and dynamics of scientific publishing and scholarly communication[13]. Altmetric promotes researchers to opt for social platforms for promotion and publication and to get more attention[14]. Altmetrics continue to be adopted by researchers, authors, and publishers since 201. A present Elsevier, Springer, Nature, Taylor & Francis, and other open-access publishers, and F1000 have embedded AAS with their articles [15]. A larger proportion of articles are discussed in the academic blogs and a larger still amount of articles are shared on the social web such as Facebook, Twitter, and Google+ and researchers seem to feel comfortable sharing their articles and discussing them on social networks tied to their identity[16].

Significance of the Study:

It is quite common among researchers, scientists, and academicians to promote their research output to reach and attract more readers. In the present scenario, it is required to study how they get benefited from social media visibility. It was found in the previous studies that there is a relationship between citations and altmetric attention scores. In this regard, it is necessary to know the social visibility of research literature and its correlation with citations.

Objectives of the study:

- To know the association between the citations and altmetrics score.
- To know the top 10 articles with the highest AAS and the highest citations.
- To find out Mendeley downloads for the selected articles.
- To know the Demographic status of the tweeters.

Methodology:

The study extracted the data from Google Metrics on 4th May 2022. Top cited articles published in Physical Review Letters journal having highest citations in the Google Scholar metrics under Physics & Mathematics category with 297 h5-median and 209 h5-index is selected. Scopus citations data is collected from the PlumX Metrics and Dimensions database chosen for the study as it had significantly higher coverage compared to Web of Science[17]. Further altmetrics data collected from Altmetric.com by far the most popular service[18].The complied facts were further analysed with the support of the SPSS to find the correlation between AAS and citations.

Results: Articles with Highest AAS and Citations:

To know the top 10 articles with the highest citations and AAS results of the analysis of the collected data are presented in *Table* 1. Among the top 10 articles, there are 7 articles written by B.P. Abbott et al. in association with the LIGO Scientific collaboration during 2016-2018. Article number-1 published in 2016 had the highest

Citations in Google Scholar (9782), Scopus (7168), Dimensions (6564) and AAS (4786). The data shows that top-cited

Article No.	Article Title	Author	Year	GS Citations	Scopus	Dimensions	AAS
1	Observation of Gravitational Waves from a Binary Black Hole Merger	B. P. Abbott et al.	2016	9782	7168	6564	4786
2	GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral	B. P. Abbott et al.	2017	5403	4729	4483	1502
3	GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence	B. P. Abbott et al.	2016	3158	2478	2239	645
4	GW170104: Observation of a 50-Solar-Mass Binary Black Hole Coalescence at Redshift 0.2	B. P. Abbott et al.	2018	2249	1774	1639	1631
5	GW170814: A Three-Detector Observation of Gravitational Waves from a Binary Black Hole Coalescence	B. P. Abbott et al.	2017	1757	1439	1315	486
6	Results from a Search for Dark Matter in the Complete LUX Exposure	D. S. Akerib et al.	2017	1673	1139	886	124
7	Dark Matter Search Results from a One Ton-Year Exposure of XENON1T	E. Aprile et al.	2018	1282	1043	793	131
8	Tests of General Relativity with GW150914	B. P. Abbott et al.	2018	1071	929	871	131
9	First Dark Matter Search Results from the XENON1T Experiment	E. Aprile et al.	2017	1033	656	522	229
10	GW170817: Measurements of Neutron Star Radii and Equation of State	B. P. Abbott et al.	2018	903	930	919	408

Table 1: Top 10 Articles with highest AAS and Citations

Online and social media attention:

The results of the data extracted from Altmetric.com shows that, Mendeley is a significant contributor to the altmetrics score which is displayed in *Table 2*. Article 1 got the highest i.e., 4551 Mendeley score, followed by Article 2 with 1086. Article 1 got 153 and Article 4 got a 117 score in view of news outlets. Similarly, Article 1 followed by Article 4 got the highest Facebook mentions compared to other articles. Article 1 with 3836 Twitter mentions and Article 2 with 1708 Twitter mentions scored the uppermost Twitter scores among the top 10 articles. It shows that apart from social media mentions, Wikipedia and Blog mentions also contribute to altmetric scores.

Article No.	Mendeley	Twitter	Facebook	Google+	Wikipedia	News outlets	Blogs
1	4551	3836	118	224	183	153	70
2	1086	1708	12	4	65	54	16

3	641	269	23	45	43	38	18
4	507	706	28	25	31	117	30
5	420	205	3	14	16	43	1
6	172	66	2	-	-	7	4
7	149	99	-	-	-	6	3
8	329	50	4	6	10	5	6
9	128	113	8	2	4	19	3
10	288	480	1	1	1	5	4
Total	8271	7532	199	321	353	447	155

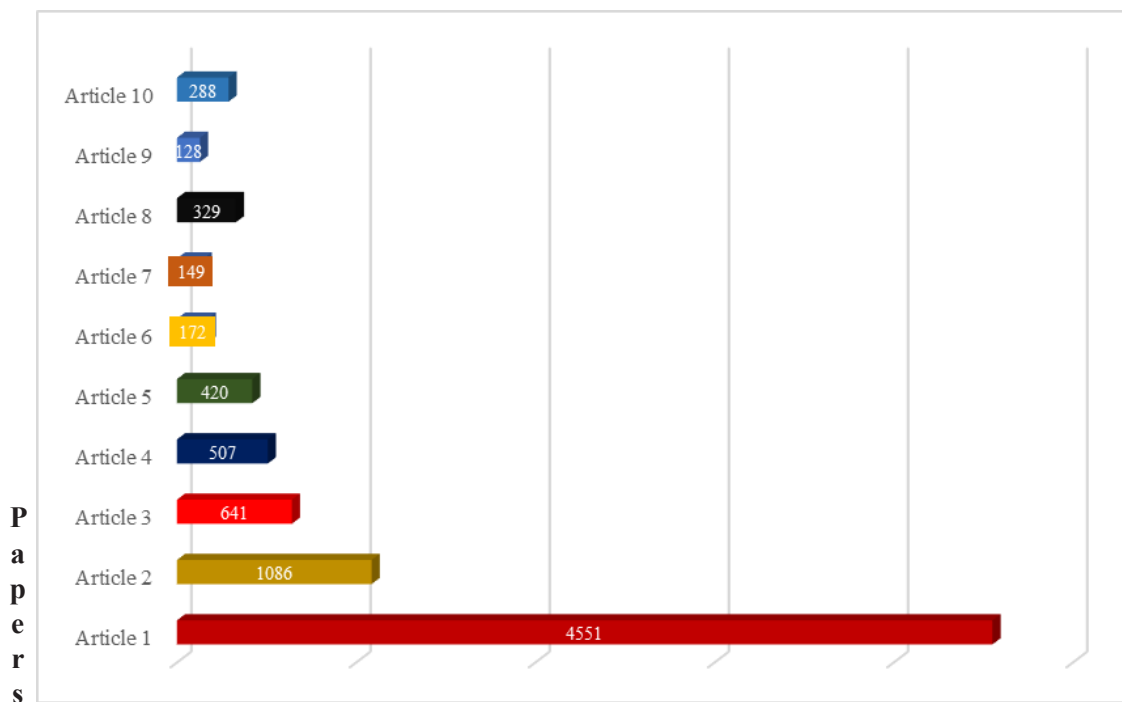**Table 2: Social Media Mentions**

Figure 1: *Top 10 Mendeley Downloads*

Correlation between Citations and Altmetrics

To test the correlations between citations and altmetrics score Spearman's rho correlations test was conducted using SPSS. Scopus and Dimensions individually compared with altmetric attention score and the *"p-value"* stood as .009 and .002 which comes ≤ the significant level shows that papers with high citations have high

altmetrics score and the value of *r* stood as .772 and .851 which shows a high positive correlation between citations and AAS (Table 3 & Table 4).

Table 3: Correlation between Scopus citations and Altmetrics score

			Scopus	AAS
Spearman's rho	Scopus	Correlation Coefficient	1.000	.772**
		Sig. (2-tailed)		.009
		N	10	10
	AAS	Correlation Coefficient	.772**	1.000
		Sig. (2-tailed)	.009	
		N	10	10
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 4: Correlation between Dimensions citations and Altmetrics score

			Dimensions	AAS
Spearman's rho	Dimensions	Correlation Coefficient	1.000	.851**
		Sig. (2-tailed)		.002
		N	10	10
	AAS	Correlation Coefficient	.851**	1.000
		Sig. (2-tailed)	.002	
		N	10	10
**. Correlation is significant at the 0.01 level (2-tailed).				

To know the demographic status of the Tweeters data was collected and listed the top 3 countries where selected articles got the highest tweets. Results show that most of the tweeters are from the United States, which is quite natural because as per Statista[19]the US has 76.9 million Twitter users which stood at the top as compared to other countries followed by Japan with 58.95 million users and India stood top 3 in the Twitter users. Even though India is having 23.6 million Twitter users got a very less number of tweets. Articles 2 and 10 have got more tweets from Japan and the other Eight articles got the highest tweets from the USA (Table 5).

Table 5: Top 3 Tweeters

Article No.	#1 Country	Tweets	#2 Country	Tweets	#3 Country	Tweets
1	US	561	Japan	565	UK	240
2	Japan	243	US	189	UK	86
3	US	48	UK	22	Japan	9
4	US	111	UK	38	Japan	37
5	US	28	Japan	24	UK	12
6	US	18	UK	6	France	3
7	US	19	Japan	6	Germany	6
8	US	11	Netherlands	4	UK	4
9	US	20	UK	8	Netherlands	7
10	Japan	83	US	39	UK	12
Total		1142		901		416

Discussion and Conclusion:

Data analysis found a high positive correlation between citations and AAS. Articles written by B. P. Abbott et al. in association with LIGO Scientific collaboration have got the highest citations according to the Google Scholar metrics, Dimensions and Scopus, and scored top in AAS as well. "Observation of Gravitational Waves from a Binary Black Hole Merger" by B. P. Abbott et al. published in 2016 stood top by scoring top citations and altmetrics in numbers (Table-1). Mendeley and Twitter are contributing more to altmetrics which can be seen in Table-2, it also can be seen in a similar study [20]. Wikipedia, Facebook, News outlets, Blogs, and Google+ also contributed to the altmetric score. The rapid growth of the web and social media play a significant role in promotion. Researchers and academics from the USA, Japan, and United Kingdom are taking advantage of the Twitter platform to share, spread and promote their research work to get more citations and to reach more readers (Table-5). It is suggested that, the Indian research community to look forward in utilizing the social media platforms effectively to attract a global audience to get more mentions and citations for their research output.

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