

## Altmetrics: Measuring the Broader Impact of Scientific Research

Pallab Pradhan, Scientist-B (LS)

Measuring the impact of scientific research of individuals and institutions is a necessity and a challenging task for institutions, funding agencies and the government so as to draw a well-informed policy framework and draw pathways for future directions. While peer-review and citation-based bibliometrics indicators have become global means of measuring research output and are playing a critical role in this process. However, citations have been criticized for limiting their scope within academic and neglecting the broader societal impact of research. The Article-level-metrics (ALM) or altmetrics has emerged as an alternative metrics (alternative to bibliometrics) to fill-in the gap and setting a new trend in recent times for measuring the impact of scientific publications and their social outreach on web. Altmetrics is the new metrics for measuring research impact based on the data penetration on the web and social media platforms like Facebook, Twitter, LinkedIn, Mendeley and CiteULike, etc. This paper provides an overview on altmetrics, its definitions, its data sources and available tools, merits and demerits, difference between altmetrics and bibliometrics, etc. Lastly, the article outlines possibilities of implementing altmetrics in publications-based services offered by the INFLIBNET Centre.

### Introduction

Measuring research impact is one of the most important activity in the process of evaluating scientific research and scholarly communication. Measuring impact of research is not a simple and straightforward task for the scientific communities, funding agencies and policy makers. Qualitative assessment like peer-review analysis is being used since the beginning of auditing of science. However, the process of peer-reviewing may suffer from subjectivity on part of evaluators. Use of citations for measuring impact of research can be traced back to publication of "Genetics Citation Index" in the year 1961 by Institute of Scientific Information (ISI). Citation-based bibliometrics studies are free from subjectivity and play an important role in measuring the academic impact of research. Gradually, several other agencies came up with their own products by integrating different kinds of bibliometrics indicators based on citation counts or their derivatives for measuring research impact. Web of Science (Thomson Reuters), Scopus (Elsevier) and Google Scholar are the three most prominent players who came up with different publication-count and citation-based parameters that can be used for measuring research impact of an article, author or organization.

Bibliometrics indicators can broadly be grouped under two categories: Journal-Level-Metrics and Author-Level-Metrics. Impact Factor (IF)/Journal Impact Factor (JIF), Eigenfactor®, SCImago Journal Rank (SJR) and h5 index, etc. are prominent examples of journal-level-metrics. Indicators like h-index, i-10 index and g-index are considered and used as author-level-metrics to measure author's productivity and impact. All these bibliometric indicators have been criticized for their limitations by the academic and research communities since these indicators consider only publication-count, citations or their derivatives to measure the impact. Moreover, the citations are collected from journal articles mostly written and published by academicians, research scholars and scientists. Thus, these indicators fail to measure the broader societal impact of research.

With launch of open access movement in 21st century, the academicians and researchers world-wide are increasingly publishing their research findings and research outputs on open access platforms, i.e. open access journals and open access digital repositories, etc. The governments and funding agencies are increasingly mandating submission of research articles emanated from publicly funded research in open access repositories and open access journals. Thus, the scholarly communication process is moving away from the traditional media of printed journals and printed books to the online, web-based open access avenues such as open access journals, blogs, digital repositories, social forums and other social media, which, put together are termed as “digital scholarship”. Increasing use of digital scholarship media resulted in quantum jump in numbers of research publications which are now available in open access platforms across the world. Moreover, the citation-based bibliometrics indicators associated with Web of Science (WoS) and Scopus do not support and consider these emerging avenues of digital scholarship, thereby failing to measure the research impact of scholarly publications published in such open and online platforms.

Altmetrics, as the name suggest is “alternative metrics” that is used to overcome the above mentioned limitations. It is used to measure the societal impact of research beyond the academics.

### What are Altmetrics?

The term 'Altmetrics' was proposed by Jason Priem on 8th September 2010, a PhD student at the School of Information and Library Science at University of North Carolina, Chapel Hill through a tweet (<https://twitter.com/asnpriem/status/25844968813>). It was tweeted as “#altmetrics” for “#article level metrics”.

Altmetrics is the creation and study of new metrics based on the Social Web for analyzing, and informing scholarship (<http://altmetrics.org/about/>). It is the study of new indicators for the analysis of academic activity based on Web 2.0. Piwowar (2013) considered the altmetrics as an interesting option for assessing the societal impact of research, as they offer new ways to measure public engagement with research output. According to Liu, Adie, Bishop, and Venis (2013); “Altmetrics indicate the quantity and quality of online attention in multiple channels, including social media, blog posts and news coverage”.

Fenner (2014) elaborated that altmetrics typically looks at individual research outputs, including journal articles, presentations, datasets, softwares, etc. Besides, it also includes usage statistics and citations. Further, he stated that altmetrics and article-level-metrics (ALMs) are used interchangeably while the later is associated with “Public Library of Science (PLOS)”, a major open access publisher. Article-level-metrics are a comprehensive and multi-dimensional suite of transparent and established metrics at the article level (<http://article-level-metrics.plos.org/alm-info/>). PLOS-ALMs collect and provide article-level-metrics for each individual article published in its own publishing platform which was started as a service in 2009 by PLOS to assess its article impact, rather them aggregating them per journal Figure-1 and Figure-2 below are the two screenshots of “impact”.

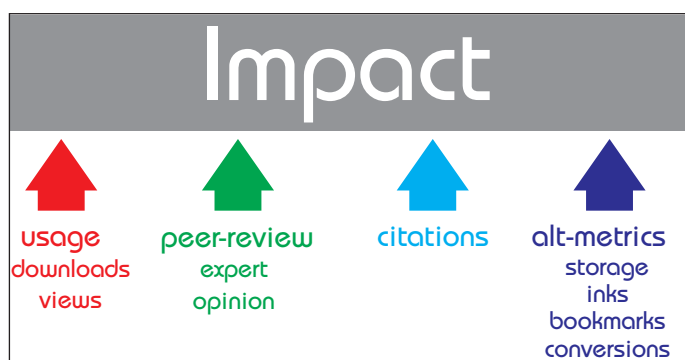


Fig. 1: Altmetrics.org, 2010

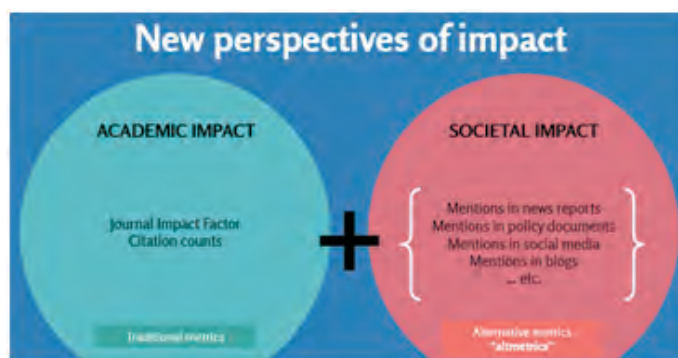


Fig. 2: Altmetric.com, 2014

Altmetrics is potentially focused on web influence rather than on only citations. It is all about measuring the impact from the various sources and platforms available on the web. According to Loria (2013), "Altmetrics measure the number of times a research output gets cited, tweeted about, liked, shared, bookmarked, viewed, downloaded, mentioned, favoured, reviewed or discussed. It harvests these numbers from a wide variety of web sources that count such instances, including open access journal platforms, scholarly citation databases, web-based research sharing services and social media. The numbers are harvested almost in real time, providing researchers with fast evidence that their research has made an impact or generated a conversation on the public forum. Altmetrics are quantitative indicators of public reach and influence. Thus, altmetrics provide a more comprehensive understanding of impact across sectors, including public impact". Shema, Barllan and Thelwall (2014) defined altmetrics as "a term to describe web-based metrics for the impact of scholarly material, with an emphasis on social media outlets as sources of data."

Open access and altmetrics goes distinctively with the same mission and both are complimentary to each other. Open access is meant for free availability of research articles through web to all, where mediums of open access like IRs, OJS, etc. are major sources for altmetrics data. Still, publishing a paper in a subscription-based high impact factor journal or in an open access journal is a personal trade-off for an author. Open access articles solely stand on its own contents but a subscription-based journal article rely on the prestige of the journal in which it is being published to some extent. Thus, a qualitative open access article would get attention and respect it deserves through altmetrics as compare to the much hyped and marketed subscription-based journal article. Altmetrics help to solely recognize the potential of an author, not of a journal as in case of citation-based bibliometrics.

Witnessing its tremendous interest among scientific community in a very short period of time, the National Information Standards Organization (NISO) is presently undertaking many initiatives to study, evaluate and examine altmetrics, and to develop uniform standards and practices for it.

### Metrics and Data Sources in Altmetrics

Altmetrics capture and assess the broad ranges of online influence of a paper or a work. It takes the data from various web sources which include:

- ☞ **Usage Data:** Altmetrics counts the number of page viewed (html & pdf) and document downloaded (pdf, postscripts, etc.) to assess its scholarly impact. Data can be counted from various databases and repositories like Dryad, Figshare, GitHub, SlideShare, etc. along with its publishing platform itself.
- ☞ **Citations:** Apart from citations tracked from the established Web of Science and Scopus platform, altmetrics takes into count the citations of a paper from other major academic social networks and sources like Google Scholar, CrossRef, PubMed, ScienceSeeker, ResearchGate, Academia.edu, getCited.org, Wikipedia, Scholarpedia, etc.
- ☞ **Captures:** Altmetrics capture social bookmarking data of a research paper from platforms like Delicious, CiteULike, Connotea, data stored in EndNote, Zotero & Mendeley, favorites in SlideShare and YouTube, followed in GitHub, and number of Mendeley readers of that specific paper which helps to figure out the impact on scholarly community.
- ☞ **Mentions:** This metrics counts the number of comments & mentions a research paper is receiving on Facebook, Twitter, LinkedIn, SlideShare, F1000, number of mentions in blog, e-news & media, on-line forums, and how many times that has been linked & mentioned in Wikipedia, etc.
- ☞ **Social Media:** Altmetrics considers the online discussions of a research article on social media like Facebook, Twitter, Google +, LinkedIn, and Reditt.com, etc.

## Tools for Altmetrics

There are mainly following four major tools for altmetrics that are available in the market place.

**D) Altmetric.com:** Altmetric, a London-based start-up founded by Euan Adie in 2011 is focused on making altmetrics easy. Its mission is to track and analyse the online activity around scholarly literature. Altmetric Explorer, their first standalone version of Altmetric was released in February 2012. Altmetric is being funded by Digital Science. It collects mentions of scholarly articles from all across the web by gathering attention from newspapers, blogs, social media, and more. For non-commercial use, the Altmetric Application Programming Interface (API) is free for all. It offers its flagship app “Altmetric Explorer” for free to librarians. (<http://www.altmetric.com>). Table-1 below lists data sources of Altmetrics.

Mainstream news	New York Times, BBC News and Washington Post, etc.
Blogs	Science blogs, etc.
Social media	Twitter, FB, G + , Weibo, etc.
Reference Managers	Mendeley, CiteULike, Connotea, etc.
Peer Review Sites	PubPeer and Publons, etc.
Policy Documents	World Health Organization (WHO), Inter-governmental Panel on Climate Change (IPCC) and National Institute for Health and Care Excellence (NICE).

**Table 1: Data Sources of Altmetric**

From Altmetric.com website, a researcher can get article-level-impact mostly on individual researcher level, institution level, institutional IR level, etc. Altmetrics use different kinds of badges to display its article-level-metrics, i.e. donut, medium-donut, small badge, medium badge, large badge, small bar and medium bar, etc. as per clients' choice. Figure 3 and Figure 4 below are examples of “Altmetric Badge” and “Display of Altmetric Scores” respectively.



**Fig. 3: Altmetric Badge**



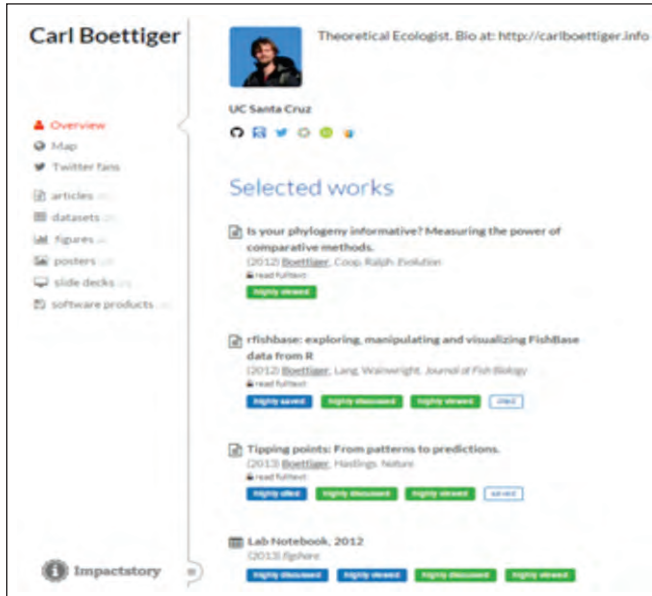
**Fig. 4: Display of Altmetric Scores**

ii) **ImpactStory:** ImpactStory is an open-source, web-based tool that helps researchers to explore and share the diverse impacts of all their research products from traditional ones like journal articles to emerging products like blog posts, datasets, and software, etc. Jason Priem and Heather Piwowar were the founder of ImpactStory. By helping researchers to narrate their data-driven stories about their impacts. ImpactStory is helping to build a new scholarly reward system that values and encourages web-native scholarship. ImpactStory was started as “Total-Impact”, a hackath on project at the 'Beyond Impact Workshop' in 2011. It is funded by the National Science Foundation (NSF) and the Alfred P. Sloan Foundation. ImpactStory is a non-profit corporation (<https://impactstory.org/about>). Table 2 below lists data sources of ImpactStory.

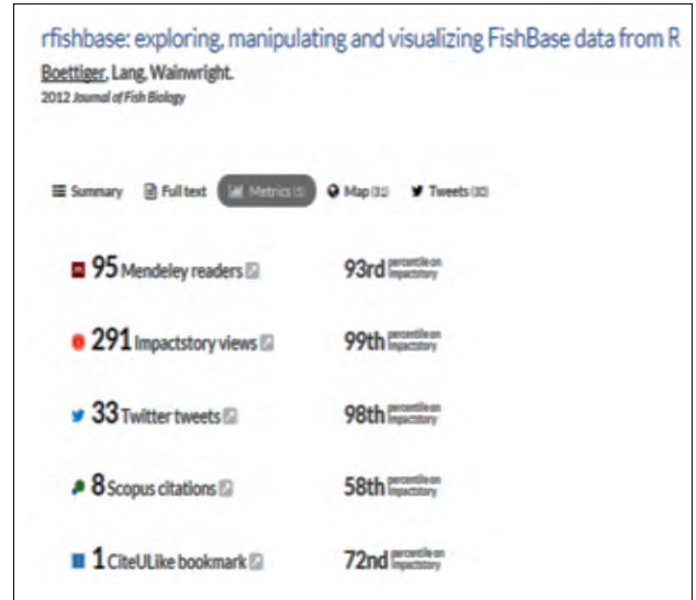
Discussed	Science blogs, journal comments, blogs, Twitter, Facebook, etc.
Recommended	Editorial Recommendations, Press Release, Faculty of 1000 (F1000)
Cited	Citations, full-text mentions, Wikipedia mentions
Saved	CiteULike, Mendeley, Delicious, Facebook
Viewed	HTML views, PDF views and downloads

**Table 2: Data Sources of ImpactStory**

ImpactStory categorizes the articles of a researcher as per the kinds of online attention an article gets, i.e. viewed, saved, cited, discussed, recommended, highly viewed, highly cited, highly discussed, etc. Figure 5 and Figure 6 below show “Researcher's Profile” and “Display of Metrics” in ImpactStory respectively.



**Fig. 5: Researcher's Profile in ImpactStory**



**Fig. 6: Display of Metrics**

iii) **Plum Analytics:** Andrea Michalek and Mike Buschman founded Plum™ Analytics in the year 2011 to figure out more accurate ways of assessing research by analyzing the different categories of metrics. Its product PlumX is the impact dashboard for measuring research output. Plum Analytics is now a part of EBSCO Information Services. It is a profit-making organization (<http://www.plumanalytics.com>). Table 3 below lists data sources of Plum Analytics.

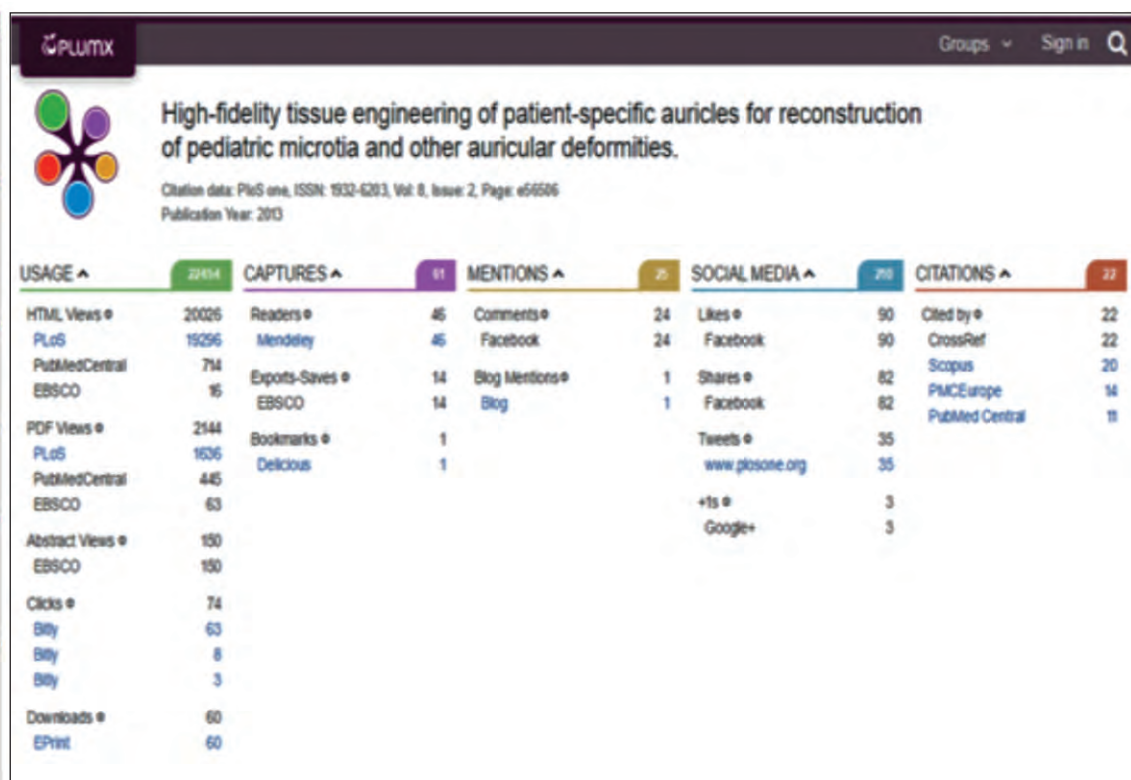
Usage	Downloads, views, book holdings, ILL, document delivery (DSpace, ePrints, PLoS, Bit.ly, Facebook, Dryad, Figshare, Slideshare, GitHub, WorldCat)
Captures	Favorites, bookmarks, saves, readers, groups, and watchers (CiteULike, Delicious, Slideshare, YouTube, Mendeley)
Mentions	Blog posts, news stories, Wikipedia articles, comments, reviews (Facebook, Reddit, Slideshare, Vimeo, GitHub, Wikipedia, Research blogging, ScienceSeeker)
Social media	Recommendations, tweets, likes, shares, ratings (SourceForge, Figshare, Reddit, Facebook, Twitter)
Citations	PubMed, Scopus, USPTO patents

**Table 3: Data Sources of Plum Analytics**

With PlumX™, a researcher can track article-level-metrics at multiple levels or groups. For example, an academic institution might track metrics at: Researcher, Lab, Department, Institution, Discipline, and Subject. PlumX™ has several types of widgets to show the article-level-metrics that a user/researcher can choose from depending upon how he/she would like to integrate into his/her site. They are Artifact Pop-Up, Artifact Summary, Artifact Details, Artifact PlumPrint, Group, Researcher and Grant. Figure 7 and Figure 8 below show “PlumX Widget” and “Display of Widgets' Scores” in PlumX.



**Fig. 7: PlumX Widget**



**Fig. 8: Display of Widgets' Scores**

iv) **PLOS Article-Level Metrics (ALMs):** Public Library of Science (PLOS), the worlds' major open access publisher has developed an altmetrics application called PLOS Article-Level Metrics (ALMs) which are available for every

article published on its own publishing platform. According to PLOS, research articles should primarily be judged on their individual merits, rather than on the basis of the journal in which they were published. Its altmetrics data on articles includes: views, citations, save, discussions and recommendation, etc. The API for ALMs is freely and publicly available since 2009. It provides a suite of established metrics that measure overall performance and reach of published research articles (<http://article-level-metrics.plos.org/>). Table 4 below lists data sources of PLOS-ALMs.

Usage	PLOS: views, PDF downloads, XML downloads; PubMed Central (PMC): views, PDF downloads
Citations	PubMed Central (PMC), CrossRef, Web of Science, Scopus
PLOS	Comments, notes, ratings
Social Networks	CiteULike, Mendeley, Twitter, Flickr
Blogs & Media	Nature Blogs, ScienceSeeker, Research Blogging, Trackbacks

**Table 4: Data Sources of PLOS-ALMs**

PLO-ALMs display its article-level-metrics in PLOS-ALM widget based on the ALM 2.0 API. It can accommodate the display of ALMs for a single or multiple articles. This widget can be used / integrated to display for one or more articles with PLOS, a lab with multiple researchers who have published one or more articles with PLOS, and university department or funding agency with many researchers and many PLOS papers. PLOS-ALM widget mostly support webpage created on WordPress platform. Figure 9 and Figure 10 below show “PLOS-ALM Widget” and “Display of Widgets' ALM Scores” in PLOS-ALM.



**Fig. 9: PLOS-ALM Widget**



**Fig. 10: Display of Widgets' ALM Scores**

Many major publishers like: Wiley, Nature Publishing Group (NPG), BioMed Central, Public Library of Sciences (PLOS), Royal Society of Chemistry, Cell Press, IEEE, Proceedings of the National Academy of Sciences of the United States of America (PNAS) and High Wire Press have already incorporated altmetrics applications into their publishing platforms to provide altmetrics data score to each individual article. Also, SCOPUS has included Altmetric badges to show altmetrics score for articles indexed in it.

### Advantages of Altmetrics

Priem, Taraborelli, Groth, and Neylon (2010) noted the limitations and slowness of peer review and citations process in their post "Altmetrics: a Manifesto" and suggested that the speed with which altmetrics data are available could potentially lead to real-time recommendation and collaborative filtering systems to assess the quality of research.

Altmetrics offer potential advantages which are broadly elaborated below:

- ☞ **Breadness:** Altmetrics has the potential for measuring the broader impact of research, that is, beyond science. It can deliver more transparent descriptions of the interest, usage and reach of scholarly products, provide more diverse and nuanced forms of impact analyses than traditional metrics. It offers access to the opinions of a wider audience, such as professionals, undergraduates, government and – as a whole – the interested general public (Bornmann, 2014).
- ☞ **Speed:** Altmetrics data collected from such web-based, open and social platforms often provide more timely data, showing the evidence of impact in days or weeks instead of years, i.e. soon after publication of a paper. The data is gathered as it is read, bookmarked, saved, annotated and discussed within academic circles and by the public.
- ☞ **Diversity:** Altmetrics data are more diverse in kinds that are sourced from diverse data sources, whereas for citation-based metrics, data source is cited references in journals. Altmetrics also allow for evaluation of a greater diversity of products, i.e. not just publications but also products, software, copyrights, algorithms, grey literature, and slides, etc. (Bornmann, 2014) from a diverse audiences.
- ☞ **Openness:** Indications of societal impact as altmetrics data are based on web-based and open access platforms.

### Limitations of Altmetrics

Despite being considered as an alternative metrics to bibliometrics in recent time, altmetrics has many flaws that include:

- ☞ It may take longer time to clearly understand the quality and applicability of a research in a broader approach.
- ☞ Social media and usage statistics are vulnerable as these can be manipulated and subject to gaming which may directly affect the altmetrics data and its result.
- ☞ There is possibility that a researcher may use various platforms extensively to promote his/her research article. Thus, altmetrics data should not necessarily refer to a greater influence or impact of research.
- ☞ Altmetrics is more interested in such things that can be measured on web like attentions, mentions, etc.
- ☞ Altmetrics has lack of presence in 'dark social' which means the social sharing of content or data that occurs outside of what can be measured by Web analytics programmes, i.e. personal emails, chats or offline sharing, etc.
- ☞ Technology is constantly changing, so is the social web platforms. The platforms, the sources that are being used for altmetrics data today may be obsolete or would not even exist in future on the web. So, there would not be accuracy in data and stability in data sources.



- ☞ There are no well-defined indicators to measure altmetrics. Different platform use different sets of altmetrics indicators.
- ☞ Social web is the base for altmetrics data which needs much more social media literacy among the scientific community. At time, researchers may not be aware of all available web sources.

### Altmetrics v/s Bibliometrics

Altmetrics and bibliometrics can be compared and differentiated on the following counts:

- ☞ **Time:** Citations took years to occur; but altmetrics data like tweets, blog posts, tags, facebook shares, comments and bookmarks tend to occur much more quickly soon after publication.
- ☞ **Impact:** Citation-based bibliometrics neglect impact outside the academic, where as altmetrics provides fast evidence of public reach and influence of a research.
- ☞ **Sources:** Citation data sources are well-recognized and universally accepted by the research community i.e. Web of Science and Scopus. Whereas, altmetrics data sources are much diverse in nature on the social web. Moreover, altmetrics parameters are not well known and used uniformly by research community and service providers.
- ☞ **Indicators:** Citation metrics have well-developed theories and methods such as Impact Factor, H-Index, JIF, etc. to measure, whereas in altmetrics, there is no well-defined and clear theories and indicators to measure the data and their sources.

### Role of Librarians in the age of Altmetrics

Altmetrics can be used as a very useful handy tool for filtering out the most fruitful and reliable research from the web. Librarians can use altmetrics to explore its use for measuring public attention to their institutional research output produced by its own faculty members and researchers. They can use altmetrics as a value-added application by integrating it with their IRs which would help them to track the use of research articles and provide article-level-metrics for all articles available in their IRs. Moreover, academic community can be informed about various hot research topics going on across the world. Figure 11 and Figure 12 below show two examples of implementation of article-level-metrics in IRs.

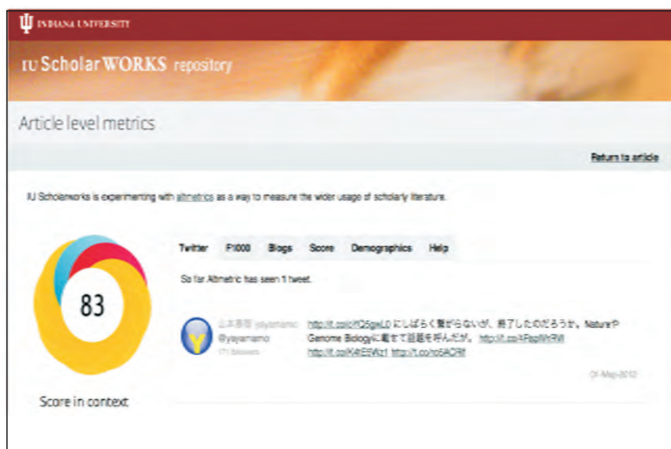


Fig. 11: IU Scholar Works Repository, Indiana University

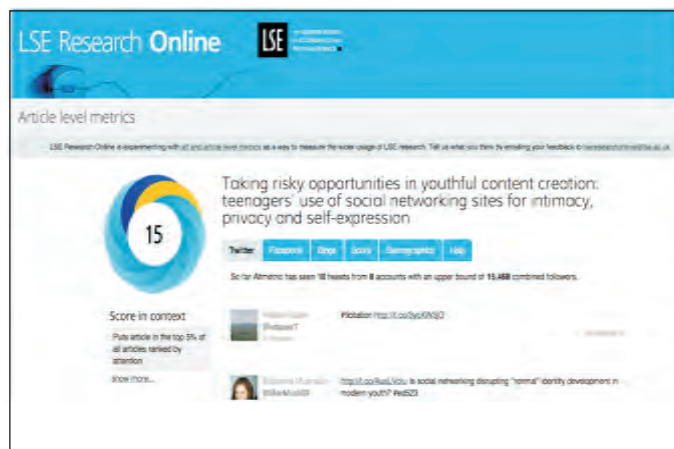


Fig. 12: LSE Research Online, LSE, UK

Altmetrics data collected from tools like Zotero and Mendeley's Institutional Edition are helping the librarians to get a quick analysis about the reading trends of its users. Mendeley is emerging as a leading source of data on how ideas

spread and which academician scientists are the most widely read and influential in their respective fields (William, 2012). Barbaro, Gentili and Rebufi (2014) suggested that with the help of altmetrics data like readership data from Mendeley, librarians can track, collect and inform emerging research conversations penetrating in the web with its research community. Recently, Scopus has started to provide article-level-metrics to all articles indexed on its platform in collaboration with Altmetric.com. Furthermore, Scopus has integrated Mendeley with its platform to provide readership statistics on individual article. Figure 13 and Figure 14 below are the screenshots of display of “Altmetric for Scopus” and “Mendeley Readership Statistics” respectively.



Fig. 13: Display of Altmetric for Scopus



Fig. 14: Display of Mendeley Readership Statistics

Librarians can support experimentation with emerging altmetrics tools to facilitate better research practices. They can engage themselves in early altmetrics education for their academic community and outreach too.

### INFLIBNET's Vision towards Altmetrics Implementation

The Information and Library Network Centre (INFLIBNET) is working on different projects to evaluate the research growth and its impact in different disciplines at the national and institutional level with the help of different bibliometrics indicators. As the concept of article-level-metrics or altmetrics is evolving around in the world, the Centre has also started exploring its possible applications and use in its services. The Centre proposes to implement altmetrics applications in its databases, Open Journal Access System (OJAS) and institutional repositories (IRs) to track the usage and to provide impact metrics at article-level to all journal articles, e-theses, dissertations and research synopses available in its repositories respectively.

### References

- 1) Loria, P. (2013). Altmetrics and open access: a measure of public interest. Retrieved from <http://aoasg.org.au/altmetrics-and-open-access-a-measure-of-public-interest/>

- ii) Barbaro, A., Gentili, D., & Rebufi, C. (2014). Altmetrics as a new indicators of scientific impact. *Journal of the European Association for Health Information and Libraries*, 10 (1), 3-6. Retrieved from [http://www.eahil.eu/journal/2014V10/N01/journal\\_2014\\_vol10\\_n1\\_barbaro.pdf](http://www.eahil.eu/journal/2014V10/N01/journal_2014_vol10_n1_barbaro.pdf)
- iii) Bornmann, Lutz (2014). Do altmetrics point to the broader impact of research? An overview of benefits and disadvantages of altmetrics. *8(4)*, 895–903, doi:10.1016/j.joi.2014.09.005
- iv) Fenner, M. (2014). Altmetrics and Other Novel Measures for Scientific Impact. Retrieved from <http://book.openingscience.org/vision/altmetrics.html>
- v) Liu, J., Adie, E., Bishop, L., & Venis, S. (2013). Poster: Using altmetrics and citation counts to assess the social and academic impact of Medecins Sans Frontieres publications. figshare. <http://dx.doi.org/10.6084/m9.figshare.684926>
- vi) Piwowar, H. (2013). Altmetrics: What, Why and Where?. *Bulletin of the American Society for Information Science and Technology*, 39(4), 8-9, Retrieved from [http://www.asis.org/Bulletin/Apr-13/AprMay13\\_Piwowar.html](http://www.asis.org/Bulletin/Apr-13/AprMay13_Piwowar.html)
- vii) Priem, J., Taraborelli, D., Groth, P. & Neylon, C. (2010). Altmetrics: A manifesto. Retrieved from <http://altmetrics.org/manifesto/>
- viii) Shema, H., Barllan, J., & Thelwall, M. (2014). Do blog citations correlate with a higher number of future citations? Research blogs as a potential source for alternative metrics, *65(5)*, 1018-1027, doi:10.1002/asi.23037
- ix) William. (2012). What flavor is your research? Take our survey on grant review and tenure decision making. Retrieved from <http://blog.mendeley.com/mendeley-use-case/what-flavor-is-your-research-take-our-survey-on-grant-review-and-tenure-decision-making/>

## Visitors

---

Prof. R. Nagaraj, Director, DA-IICT, Gandhinagar

Dr. Jagdish Joshi, Offtg. Director, UGC-HRD Centre, Gujarat University

Dr. Shailesh Yagnik, Head, Library and Information Services, MICA, Ahmedabad

Prof. I. K. Ravichandra Rao, Professor, PES Institute of Technology, Bengaluru

Dr. P. Dastidar, Director, Ministry of Earth Sciences, New Delhi