Tweets Do Measure Non – Citational Intellectual Impact

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Structured Abstract

Purpose: The aim of the paper is to identify the motive behind the social media indicators in focus to tweets and attempts to identify what is measured or indicated by tweets, based on these motives.

Design/methodology/approach: Documents with non zero tweets were manually collected from a source of 5 journals – Nature Biotechnology, Nature Nanotechnology, Nature Physics, Nature Chemistry and Nature Communications for the period January 2014 - October 2014 so as to depict the contemporary trend, as tweets tends to have L shaped curve in time-wise distribution.

Findings: Investigations suggest that the motives behind the tweets are research reach, research acceptance and research usage. Further analysis revealed that the motive behind self – tweets are research visibility, which is one of the attributes of social media and therefore self tweets may not be a complex problem as expected seeing that documents are self tweeted not more than once in most cases. Furthermore, identifying and classifying tweets based on users - Publishers, Frequent tweeters who apparently tweet all documents of an issue and Authors will increase the effectiveness of altmetrics in research evaluation. It was also found that association between subjects can be identified by the analysis of tweets pattern among subjects.

Originality/value: Study proposes an overall hierarchical structure of impact based on the change/advancement instigated. The study confirms that tweets do measure non – academic intellectual impact that is not captured by traditional metrics.

Keywords: Tweets, Social media indicators, Altmetrics, research impact, Twitter user motive, research reach, research acceptance, research usage

Introduction

Altmetrics the emerging new metrics is the hot topic of debate among the research community. Howard (Howard 2014) explained altmetrics as a metric that aims to measure the Web driven Scholarly interaction. The active problem in hand is to decide *if altmetrics can be accepted or not in evaluating the research impact and if so, how?* Before starting to ponder over this question, it is important that we understand the meaning of the term *Research Impact*. Research results are produced in the forms of research outputs like journal articles, reports, etc. These results when reaches the potential users are used and reused based on which there comes the change in the community; thus impact is created. In other words, impact can be explained as the number of people who change their thinking or practice because of a research (Allen et al. 2013). Either way Impact is directly and indirectly based on *research reach* and *research acceptance*. While there is no standard definition framed by bibliometricians for the term 'research impact', there are definitions in use by research evaluation institutes and organizations. Research Councils UK defines research impact as 'the demonstrable contribution that excellent research makes to society and the economy' where demonstrable is the key aspect, stating that it is not enough to focus only on research outputs like publications in high quality journals but also to provide evidence that it has been accepted and used by potential users that led to change in the community.

Australian Research Council (2013) defines Research impact as "the demonstrable contribution that research makes to the economy, society, culture, national security, public policy or services, health, the environment, or quality of life, beyond contributions to academia."

Science Foundation, Ireland (2013) interprets impactful research as the research that supports teaching that contributes to the body of knowledge that helps companies to be better managed, that influences public bodies and policy makers, that benefits society or the environment or that contributed to the economic development. A common idea that can be perceived from the above definitions is that research impact is measured based on change not only in the academic area but also in the society.

Therefore it is acceptable to understand that "any research contribution that changes the thinking or practice of individuals or organizations which results in improvement makes an impact"(Allen et al. 2013).

<u>Why altmetrics have a role to play?</u>

To measure the impact of research findings is to measure the change in the society, for which the traditional metrics cannot be of much help as they focus only one aspect of research outcomes, whereas social media covers diverse document types and user community including interested practitioners, lay man and fellow scientists who may not cite research findings. One might argue that there is no significant need to consider altmetrics in research, evaluation but, considering the impact outside academia (altmetric indicators) this approach indirectly improves the quality of scientific productivity. In other words, altmetrics when included in research, evaluation will drive scholars to produce findings with the requirements of user community. For instance, due to the implementation of Academic Performance Indicators (API) scores by Indian Government in Universities a tremendous growth in the rate of scientific publications can be witnessed while the quality of the publications have gone down(Sri Amudha & Sevukan, 2014). A recent press release by John Wiley & sons (2014) advocated the

importance of altmetrics by stating that the addition of altmetric data to its journal as Altmetric helps authors better understand the impact of their articles. The sequential stages the research findings undergo to create an impact is depicted in figure 1.
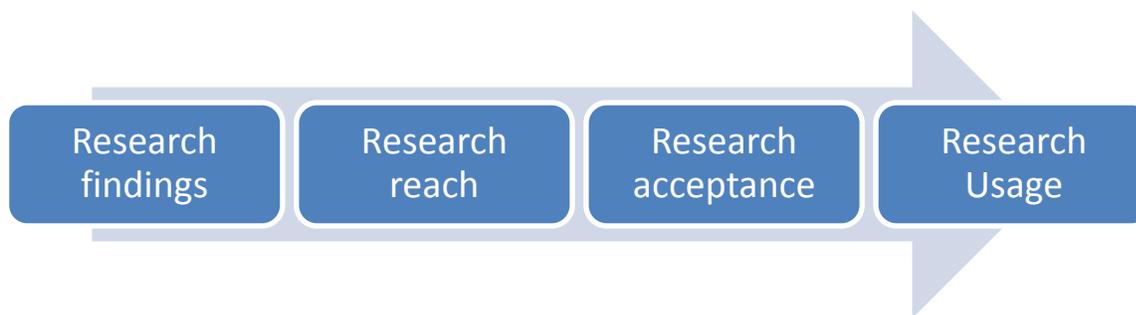

Fig.1: Sequential stages of Research Impact

The stages when closely monitored can bring out useful information that helps in research development and evaluation. Traditional metrics captured only the scholarly communications of last stage where as with altmetrics it is possible to track scholarly communications in most of the other stages thus having a wider impact view. Galligan and others (2013)and others in their paper pointed that new metrics offer the possibility to discover new insights into impact that have been previously impossible to obtain. As scholarly communication happens in online too, altmetrics can be a great tool in monitoring different online activities in different stages of research findings in online environment with the potential to capture tacit knowledge. Priem and others (Priem et al. 2012) explained that scholars are growing and they use media other than journals to interact with literature which leave valuable tracks behind them–tracks with potential to show informal paths of influence with unprecedented speed and resolution. Many of these online platform offer open APIs, supporting large-scale, automated mining of online

activities and conversations around research object. However, activities like downloading, sharing, liking, recommending (via F1000) etc., collectively reflect the research outcomes based on acceptance and usage of research. As a result, research acceptance and usage are very difficult to segregate. This is the one reason considered to obstruct the direct use of altmetrics in measuring research impact. Galligan and Dyas (2013) also observed this as the only constraint with altmetrics is that no standard way of interpretation is available for those big data tracked to give clear meaning. As depicted in figure.1, published research outputs have to reach potential users to get accepted and used. Research with no usage equals to no work done. Only when the research reaches the potential users, it can serve its purpose. Third law of Library Science "Every book (information) its reader (end users)", when interpreted in this context, clearly states that all research works are informative and are used only if they reach their potential users. Therefore to make impact it is necessary that the research reaches the target users. Social media is a boon to researchers as it disseminates information fast and far easily. This was empirically proved (Allen et al. 2013) in a study on Clinical Pain sciences that social media release of a research article in the clinical pain sciences increases the number of people who view or download that article. Researchers do not take much effort in disseminating their work to the potential users compared to their effort in publishing it. Adapting altmetrics will solve this problem as it indirectly promotes dissemination plus social media pushes the knowledge to the end users (Lavis et. al. 2003). Altmetrics collect total views of published works which directly reflects research reach. Altmetrics is also a great tool to identify if the research findings properly reached the potential users and promotes dissemination which in turn enhances the usage of the research. Social media Twitter reflects

both research reach along with research acceptance geographically. Altmetrics will be possible to proactively identify target audiences, which might be geographical, disciplinary or demographic and to ask whether they are being reached and how distribution might be modified to maximize(Neylon, C., Willmers, M., & King 2014). Altmetrics reports can even suggest potential collaborators or journals (Galloway et al. 2013).

Likewise, according to the definition of impact by Allen and others, the measuring of these research outcomes (acceptance and usage) will lead to the measure of research impact. Consequently, Altmetrics when adapted in a meticulous way has a key role to play in measuring the research's societal impact while the academic impact is largely covered by traditional metrics.

What is measured by Altmetrics?

Jason Howard (Howard 2014) commented on altmetrics that "It's like we have a fresh snowfall across this docu-plain, and we have fresh footprints everywhere, and that has the potential to really revolutionize how we measure impact. Clear understanding of what is measured and how, is needed to frame a complete definition of the term Altmetrics. At first attempts were made to identify this by looking for correlation between altmetrics and traditional metrics. Major part of Altmetrics' is accumulated from twitter(Thelwall et al. 2013) for this reason, much attention was given to tweets with the aim to find correlation between traditional metrics and altmetrics. A meta- analysis was recently conducted (Bornmann 2014) with the results of 7 studies which share the above mentioned common aim. The results of the Meta -analysis observed no correlation and concluded that both measure different aspects of research impact. In addition, Alhoori & Furuta (2014) investigated on both article and journal levels, if scholarly impact based on traditional metrics are related to altmetrics. Results showed the absence of high correlations between altmetrics and citation- based metrics which they interpreted as the differences between scholarly and social impact. Another study (Haustein et al. 2014) claims

altmetrics' association with citations along with the interpretation that metrics correlating with citations also reflect the academic impact, the study also puts forth that altmetrics capture the influence of scholarly publications on a wider and different section of their readership than citation counts, which reflect only the behavior of publishing authors. ABLE 5In short, various studies focused on finding correlations between tweets and citations, resulting in no higher correlation with citations leaving a hint to examine diverse research tweeters so as to identify what is measured by tweets if not the impact measured by traditional metrics. This situation demanded an investigation of the following research questions.

1. Are the type of documents tweeted influenced by the discipline?
2. Does any specific pattern occur in the type of documents that gains tweets?
3. What type of documents gets tweeted the most?
4. Who publishes tweets citations in twitter platform?
5. What are the motives behind the tweets?

Data collection and Methodology

A study shows the number of tweets varies among disciplines therefore, various range of all scholarly documents published that had non-zero tweet(s) were collected from a source of 5 journals Nature Biotechnology, Nature Nanotechnology, Nature Physics, Nature Chemistry for the period January 2014 - October 2014 along with random documents with non zero tweets selected from multidisciplinary journal Nature Communications so as to have wider coverage. Casual observation showed that documents are widely tweeted in recent months which the study presumes as harbingers of Scholar community adapting to scholarly communications in social media platform. For this reason the study limited the scope to documents for a period of one year aiming to depict the contemporary trend. Together the sample data set included 500 documents with 3640 tweets.

Master record of each document consists of both citation and altmetrics details along with their bibliographic details in MS excel. Tweets were clustered into different groups manually based on document types, user types and discipline to create different tables at first. Further manual analysis of the tweets of every single document in the tables created was done meticulously in a motive to find answers to the proposed question so as to identify who tweets research and in what pattern. Another separate table was created for the documents that had at least one citation to investigate the relationship between academic impact and societal impact. Based on the user category the tweets come from, the type of change instigated was identified and thus the motives behind the tweets were obtained. Finally a hierarchical structure for impact was proposed based on the how the research findings are being used.

Observations and Findings

Original research articles hardly get tweeted

Four disciplines Physics, Nanotechnology, Biotechnology, and Chemistry were considered for discipline-wise investigation. Interestingly, observations revealed that discipline has influence over the type of document that gets tweeted. This is probably due to varied user behavior across disciplines as already suspected (Priem, J., Costello, K., & Dzuba 2012). Apart from research articles, Nature publishes scientific research under News and Views, Editorial, etc., hold issues of general interest to scientists including current affairs, science funding, business, scientific ethics and research breakthroughs. Among them scientific research including significant new advances and original research are published as either articles or letters. One surprising observation was 'News and views' were greatly tweeted than original research articles and other type of scholarly documents, irrespective of disciplines (Table 1). This shows

that documents that get widely tweeted carry content that are momentous and futuristic in nature. From this, we interpreted that tweets reflect the document that holds noteworthy information in any field of study. Also, Chemistry and Physics had a very similar pattern of tweets percentage among diverse user categories (Table 2). This held true even when segregated and analyzed the documents of these disciplines from Interdisciplinary journal, *Nature Communications.* This clearly shows the obvious relationship between the disciplines. Also Biotechnology and Nanotechnology had more percentage of tweets from Science bloggers which reflects that the active scholars in the field which consecutively indicating more possibility for further exploration in the field. Between Physics and Nanotechnology, out of the 5 top tweeted document type, 4 document types were in common (Table 1). This is because Nanotechnology is in liaison with Physics to a greater extent. Likewise to our surprise, Chemistry and Biotechnology documents had similar pattern where in contrast to the former pair where their editorials scarcely got tweeted. This is due to the underlying association between Chemistry and Biotechnology. Though Biotechnology and Nanotechnology are interrelated, these altmetrics patterns have the potential to identify and reflect the closely related disciplines. With the data available, average tweets per document was calculated to find the discipline that widely tweets research. Interestingly, Even with less number of documents tweeted in Chemistry, the average tweets a Chemistry document got was the high (Table 3). This shows the active social media users in Chemistry. Surprisingly, this analysis again showed high correlation between Physics and Nanotechnology while Biotechnology correlated with Chemistry. This analysis clearly shows that like a citation pattern differs with disciplines, tweeting pattern is also influenced by discipline with more details to the user behavior.

Table 1: Discipline wise top tweeted document types

Nanotechnology		Chemistry		Physics		Biotechnology	
News and views	**10**	Article	9	Editorial	11	**News and views**	**86**
Feature	9	**News and views**	**7**	**News and views**	**9**	Commentary	10
Letter	8	Thesis	5	Letter	8	Feature Patents	7
Editorial	6	In your choice	5	Article	6	Editorial	6
Review	3	Review	3	Feature	3	others	2
Thesis	3	Editorial	2	Books and art	3	**TOTAL**	**111**
Correspondence	2	Blog roll	2	Thesis	3		
Research Highlight	2	Others	2	Commentatory	2		
Article	2	**TOTAL**	**35**	Correspondence	1		
Classroom	2			**TOTAL**	**46**		
Others	3						
TOTAL	**50**						

Table 2: Tweets pattern between Physics and Chemistry

Journal/subject	Public	%	Practitioners	%	Scientists	%	Science Communicators	%
Nature Chemistry	212	59	3	1	134	37	12	3
Nature Physics	154	57	2	1	102	38	10	4
Nature Communication (Chemistry)	41	85.41	0	0	7	14.6	0	0
Nature communication (Physics)	110	86.61	0	0	17	13.4	0	0

Table 3: Distribution of tweets across disciplines

Subject	Documents	Tweets	*ATPD
Chemistry	35	361	10
Biotechnology	111	955	9
Communication	258	1794	6.95
Physics	46	268	6
Nanotechnology	50	262	5
Total	**500**	**3640**	

Why and who tweets research?

The Tweeters were presented in four categories - Public, Scientists, Practitioners and Science Communicators in Nature journals. For convenience of analysis, this study adopted the same categorization. Analysis showed an interesting fact that numbers of tweets made by scientists (590) were found to be half the numbers of tweets made by Public (1180). Tweets by public were exceptionally high (Table 4) (Figure 2) consisting of 61% in approximate of the total compared to tweets by other users Scientists(33%), Practitioners (1%), and Science communicators(6%) both in individual disciplines and in total displaying evidence for altmetrics tracking impact outside academia which otherwise is the societal impact. Further confirming this, a manual comparison was done between the profiles of scientists who tweeted the document and the scientists who cited the same. Results showed that the profiles of the scientist who tweeted and scientist who cited were unique favoring that altmetrics (twitter in specific) track impact that is distinct from traditional metrics (Table 5). Along with this an another observation (Table 4) where tweets from practitioners and bloggers were found to be always lesser than 10%, shows that the major part of the tweets are from academicians (peer group) compared to the people who does practical application of research in real life. As twitter

platform is not devoted for scholarly communication by nature (Haustein et al. , Holmberg & Thelwall 2014), arriving to the conclusion that majority of the tweets are from academicians motivated to investigate the twitter self citations. Again a manual observation of tweets of all sample documents was done. Contradicting the study (Mahrt et al. 2014) stating "Twitter self-citations probably represent a greater problem than self-citations with traditional metrics", it was found that documents in the sample were either hardly self tweeted or they were self tweeted not more than once according to the manual individual record analysis hence making the issue no longer complex.

Table 4: Distribution of tweets from diverse users group

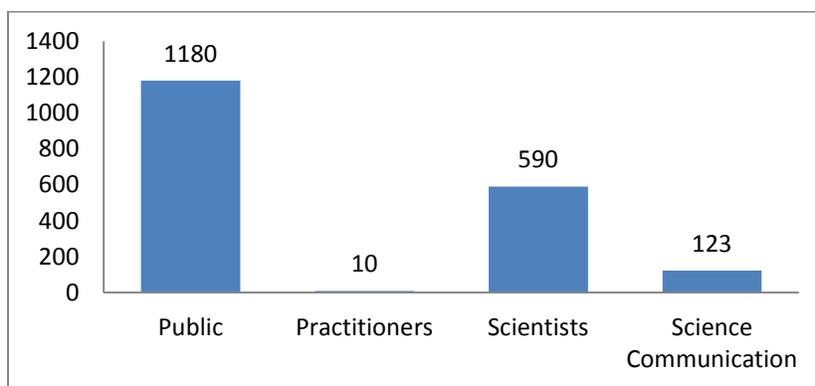| Subject	Public	%	Practioners	%	Scientists	%	Science Communicators	%
Biotechnology	611	64	2	0	269	28	73	8
Physics	154	57	2	1	102	38	10	4
Nanotechnology	203	63	3	1	85	27	28	9
Chemistry	212	59	3	1	134	37	12	3
Total	**1180**		**10**		**590**		**123**	**1903**

Fig. 2: Display of high tweets from public

However, these observations cannot be considered as concrete evidences to show higher involvement of layman over scientists as the investigation also recognized a tenuous

classification of the twitter user types by Altmetrics.com. No specific definitions for the categories was found to result in a situation where Twitter accounts that had no information on location (e.g., Reddit), accounts that did not explicitly specify it as scholars (e.g., PSMT Lab) was categorized under public. Official *Nature Physics* as well as *Nature Future* twitter accounts which are categorized under 'scientists'. Moreover, it is not certain if the tweeters are layman or erudite. Also there are accounts like 'Assembly papers', 'CompBip Papers' and likewise those frequently tweeted the newly published documents and are categorized under public even though they belong to the scholarly community in an obvious way. Like already discussed, although the motive of the publisher is to increase visibility focusing on research reach, possibility is more to get categorized along with online attention/acceptance (impact) if only the numbers were considered. Another peculiar observation was among the four disciplines analyzed, there were frequent tweeters who tweeted the entire publications of a particular issue. Clearly, all their motive was to increase visibility and this showcases the difficulty in differentiating research reach, research acceptability and research usage in an online social platform. After all Scholars, not common man can understand research findings and as well as use in his daily life. Also, no evidence exists to prove if tweets are from general public (layman). Adding to this argument, a study (Holmberg & Thelwall 2014) on twitter users in general had already showed that Twitter is used by scientists and those interested in science mainly to publicize (or to discuss) scientific results (and other products of scientific work, such as data sets) and to follow (or to comment on) live events in science (conference talks or workshop discussions. Based on observation, this study strongly advocates that classification of tweets as Public, Scientists, practitioners, and Science communicators is not effective. Rather classification has to be based on the motive behind for better precision which is proposed in the following section.

Table 5: Analysis of documents based on citations and Tweets

DOI	Document Type	Subject	Public	Practitioners	Scientists	Science Communicators	Citations	Self Tweets
doi:10.1038/nbt.2840	Correspondence	Biotechnology	23	0	29	2	4	1
doi:10.1038/nbt0714-603	News	Biotechnology	1	0	3	0	1	
doi:10.1038/nbt0614-501	News	Biotechnology	11	1	3	1	3	
doi:10.1038/nbt0214-116b	News	Biotechnology	7	1	0	1	3	
doi:10.1038/nbt.2944	Commentary	Biotechnology	5	0	7	2	1	1
doi:10.1038/nbt0114-9a	News	Biotechnology	0	0	1	0	4	
doi:10.1038/nbt.2794	Feature	Biotechnology	17	0	2	1	12	1
doi:10.1038/nchem.1836	Article	Chemistry	4	1	2	0	17	1
doi:10.1038/nchem.2022	Article	Chemistry	3	0	1	0	1	1
doi:10.1038/nchem.2031	Review	Chemistry	10	0	6	2	2	
doi:10.1038/nchem.2041	Article	Chemistry	5	1	5	0	2	
doi:10.1038/nphys3030	Article	Physics	0	0	0	0	2	
doi:10.1038/nphys3071	Article	Physics	1	0	0	0	1	
doi:10.1038/nphys3034	Letter	Physics	4	0	0	0	1	
doi:10.1038/nphys2874	Correspondence	physics	0	0	1	0	1	
doi:10.1038/ncomms4165	Article	Physics	9		1	1	2	
doi:10.1038/nnano.2014.169	Letter	Chemistry	3	1	0	2	1	
doi:10.1038/nnano.2014.110	Correspondence	Nanotechnology	1	0	0	0	2	
Total			104	5	61	12	60	5

Hierarchical structure of Research impact

After examining the pros and cons, various studies approved and foretold the potential of altmetrics to revolutionize research evaluation by including varied scholarly communication nevertheless no proper terms have been proposed yet to classify the traditional metrics and the new evolving metrics. Altmetrics is already used to display research impact where scientists are permitted to use altmetrics to demonstrate social impact in reports for the Research Excellence Framework (REF), an evaluation of UK academia that influences funding, which is a perfect lead in this stage(Jump 2014). Henceforth it is necessary we come up with a standard definition for multifaceted impact. As a result, with the observations made, this study proposes a new model to differentiating impact both inside and outside academia is displayed in figure 3.
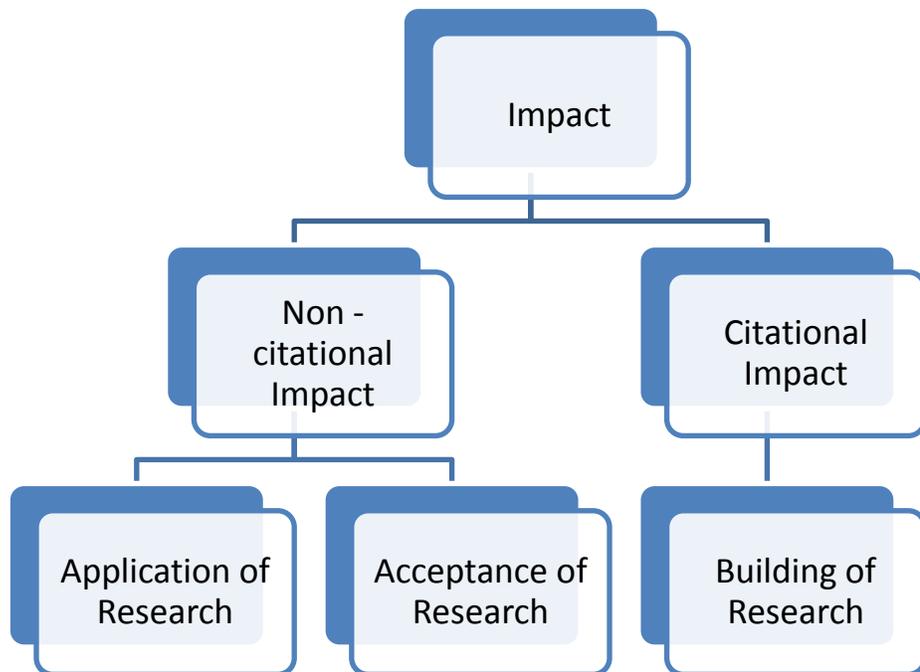

Fig.3: Hierarchical structure of impact

Expositions of the elements proposed in the above hierarchical structure are,

Citational Impact can be understood as the usage of knowledge inside academia resulting in creation of new knowledge. For instance, citing a research article to support a claim made in new research article, which is well captured by traditional metrics.

Non-citational Impact can be understood as usage of existing knowledge without resulting in creation of new knowledge. Further, Non academic impact can be of two types, Research acceptance and Research application (reuse) excluding the usage inside academia. This includes classroom teaching, debate etc. Research acceptance is included under non academic impact based on the definition of impact framed by Allen and others. (Allen et al. 2013). Research acceptance is otherwise known as Intellectual impact. These are tracked by altmetrics.

Scientists though have their base in academia, they can be considered as potential user of the society as they are not likely to produce new research findings. This was reflected with unique user profiles in both scientists who tweeted and Scientist who cited. Their feedbacks might be based on either research reuse (classroom teaching, discussions, etc.) or research acceptance due to influence in knowledge base.

Practitioners are one potential user community who tends to apply the research findings in the real life scenario or in the society. Their feedback is also significant in disciplines that have more scope to directly apply/use their findings in society. Their feedback can be the sign of positive results of research findings when reused or implemented.

A Layman, to understand research findings needs prior knowledge. Though feedback from layman community who read frequently is significant, they cannot be considered as potential users as not all disciplines' findings cannot be used in daily life although there are users who read for knowledge base. Therefore, their feedback reflects their research acceptance and not research usage.

Self tweeters, apart from tweets from all the above discussed users are tweets that aimed at higher visibility. These tweets are highly from publishers and scholarly alert groups, plus negligible amount of self tweets by authors. These tweets reflect research reach.

With the motives identified based on diverse tweeter (user) types, the possible classifications of tweets are,

- *Application of findings* (Reuse) – Tweets from Scientists and Practitioners
- *Acceptance of findings* (Intellectual impact) – Tweets from Layman, Practitioners, and Scientists.

One might argue, these tweets from scientists reflect the academic impact, nevertheless this study strongly advocates this tweets reflect societal impact as these tweeters are potential users from the same domain who are probably not likely to produce research articles but have been influenced by the research (Intellectual impact). Furthermore, an exploratory analysis of highly tweeted documents concluded that that tweets do not necessarily reflect intellectual impact adding that top-tweeted articles are a mix of curious stories, funny articles or those with

medical implications (Haustein et al. 2014). Findings of this study explain this is because other document types are widely tweeted compared to research articles. Documents under other categories like news and views, letters, etc., are prone to have curious content. Also that conclusion was based only on a sample of highly tweeted articles. This is also an evidence for altmetrics' potential in tracking the whole scholarly communication. Sentiment analysis of all samples of this study was done manually, which revealed that tweet citation for research articles were not greatly affected by article title. Moreover, because a scientific document contains funny or curious stories, those cannot be considered non – scholarly, and they are still scholarly content with usual scholarly techniques applied. For instance, the article *'Pathology in the Hundred Acre Wood: a neurodevelopment perspective on A.A. Milne'* has published a curious content attracting many tweets including tweets from the public, nevertheless it also had 10 response articles published along with 10 citing articles. Probably this way, the content seems appealing and explicable for the all users especially the common people. This could be a reason for high tweets for such documents. Altmetrics is all about tracking the impact beyond academia and not limited to scholarly impact beyond academia, even though they constitute a high percentage. Henceforth, the study suggests considering any change in knowledge base due to any published scientific literature as intellectual impact. In spite of this, there were a considerable amount of tweets that were unique reflecting the research acceptance. Nobody would tweet posts that they don't believe in. However, tweets with its word limit (140), implausible user classifications and high tweets from public users, are likely to be more inclined to research acceptance rather than research reuse in the society. This is also due to reason as rightly claimed by Allen and others claimed that even with the apparent acceptance of research

usage (social media reach, engagement and virality) being evidence of impact, no empirical evidence exists to support this claim (Allen et al. 2013). Accordingly, results on twitter, user analysis displayed evidence for tweets reflecting research acceptance, henceforth, Twitter citations are categorized under '*Acceptance of research*' in the proposed classification.

Does Social media measure Intellectual impact?

The Findings of this study give direction to categorize the impact in a different perspective leading to classify the tweets. A study , while explaining the relationship between reach and impact they also stated that it is difficult to capture the change in practice or knowledge and perhaps this is one reason that we believe erroneously, social media reach as a measure of social media impact (Allen et al. 2013). Findings of Darling et al are strong evidence for intellectual impact reflected in tweets, showing that tweets written about the results of a paper indicate more about the most interesting discoveries or conclusions than the title or the abstract of a paper (Darling, E. S., Shiffman, D., Côté, I. M., & Drew 2013). Additionally the observations of this study clearly shows a pattern that research reach follows consecutively showing a possibility to segregate research reach from research acceptance and research usage. No Scholar would share a post on a social media platform which he/she doesn't acknowledge. Furthermore, NISO is currently progressing with potential questions on Altmetrics and their survey results on NISO Alternative assessment Potential Action items showed that Developing strategies to increase trust gained second priority (Carpenter & Lagace 2013). On that ground, usage of the term 'Social Media Impact' itself deviate the focus from

impact beyond academia to social media. This invokes the suspicion on manipulation of data. However, Kelley (Kelley 2012) suggests that the volume of data available may serve to inhibit gaming because patterns are easily detected in big data. Therefore this study suggests the term *'social media indicators'* which may be more appropriate to measure intellectual impact.

Conclusion

Based on an interesting observation of this study, that documents are self tweeted not more than once, mainly by publishers, the study strongly claims a possibility to reduce the effect of self tweets. Yet, the motive behind self tweet is research visibility which is one of the attributes of social media as a result classifying the tweets from publishers and authors under separate category will help in segregating research reach and research acceptance to an extent. Further analysis with bigger sample can be done to find if this pattern holds true for bigger sample, consecutively leading to the development of a model to have control over self tweets. Attempt at predicting the motive behind the tweets contributed to the classification of social media indicators based on the type of advancement they lead to, which in turn advocated classifying tweets under non-academic impact. The study claims that the motive behind the social media indicator can possibly be research reach, research acceptance and research usage. However, it confirms the motive behind the tweets as research reach and research acceptance and claims that tweets measure intellectual impact. Different social media can indicate different motives therefore other social media indicators can be further analyzed based on the above suggested motives to identify what they measure.

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