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Library and Information Science Journals

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Unwrap Citation Count, Altmetric Attention Score, and Mendeley Readership Status of Highly Cited Articles in the Top-tier Library and Information Science Journals

Introduction

Citation count is a quantitative method of measuring the impact of a research work. A higher citation count may indicate that the research work receives more attention among peers which could mean that the research contributes value to that discipline of literature. Citation count sums the number of times that an article is referenced by other authors. Tracking citations is important; however, the citation impact only tells a part of the story from academic researchers who conduct and publish research works. The impact of the publication on leisure readers and non-publishing readers are ignored. Furthermore, it is difficult to set a standard impact measurement across disciplines. Research showed that articles in the hard sciences (e.g. chemistry, biology) tends to gain more citations than in soft sciences (e.g. social science, psychology) (Harzing, 2010; Nederhof, 2006). Even in the same field, articles that focus on praxis often receive less citation count than those that focus on theories. However, articles that focus on practice are valuable, and should be a part of the academic landscape (Akers, 2017). Finally, measuring the value of a newly published article with citation count can be difficult, since citations grow gradually over the years.

The emergence of electronic publications and web technology allows people to view a research output by the amount of attention it receives. Web-based tools such as F1000, PLoS, Altmetric, Plum Analytics, CiteULike, and Mendeley collect a publication's output through a variety of online sources. These usage statistics such as number of views, downloads, mentions, etc., disclose the popularity or influence of a publication to some degree (Zahedi, Costas, & Wouters, 2014). Mendeley readership — a feature of Mendeley Web powered by Scopus — allows researchers to monitor the impact as well as the usage of their scholarly work (Bonasio, 2014). Altmetric attention score (AAS) generates a research impact score by weighting the attention that an article receives from social media, blogs, news, and other online sources. AAS presents a quick,

multifaceted way to demonstrate the value of a research that is arguable more robust than citation count (Huang, Wang, & Wu, 2018).

Since works in the arts and humanities typically do not receive as many citations as other disciplines, the traditional bibliometric may not be a good indicator of research impact — AAS is more considerable in fields that measure researcher and reader behaviors like searching, reading, and sharing (Cho, 2017). As an increasing amount scholars and researchers in academic disciplines create their online research profile on academic network (e.g. Academia, ResearchGate, LinkedIn, Mendeley) or share their research via social media, the online attention has become a valuable aspect and a non-delay algorithm to measure research impacts (Aharony et al., 2019; Garcovich, Ausina Marquez, & Adobes Martin, 2019).

Literature Review

AAS, launched in 2010, is an innovative metric that measures a publication's impact based on the attentions it gets in lieu of the traditional citation count (Priem, Taraborelli, Groth, & Neylon, 2010). The metric uses public APIs to track online research output from social or news media, blogs, twitter, reference managers etc. For social impacts, each source is weighted by points from 0.25 to 8 for per mention. For instance, a news report counts eight points, while a blog post counts five points. Afterwards, an article's AAS is calculated based on number of mentions and weighted points from each source. To visually communicate its results, Altmetric uses a unique “donut-shaped” graphic that allows users to keep a pulse on an article's AAS score and its imprint on various digital platforms (Galligan, 2013; Mcfedries, 2012). In addition to the score, Altmetric provides detailed information about the sources and demographic distribution of readers (Altmetric, 2018). While there is a broad idea of how Altmetric selects sources and how weighting scales are set for aggregation, it is unclear how Altmetric develops its algorithm in terms of why certain sources were selected and how weighting scales were set for aggregation (Huang, Wang, & Wu, 2018; Robinson-García, Torres-Salinas, Zahedi, & Costas, 2014). Despite this, more and more researchers, administrators, and publishers have adopted AAS as a

supplemental way to highlight a publication's impact in academia (Costas, Zahedi, & Wouters, 2015). For example, Indiana University — Purdue University Indianapolis includes alternative metrics in their tenure/promotion preparation guidelines (IUPUI, 2019). Over 2,200 academic libraries share various creative ideas to faculty and scholars on how to use AAS highlights their intellectual contributions, as well as how to temperate the merit of score via Libguides (Springshare, 2018). Traditional publishers (e.g. Elsevier, Nature, Springer, and Taylor & Francis Group), as well as open access publishers (e.g. F1000, Public Library of Science (PLOS), and PeerJ)) embed AAS next to an article to help showcase its impact with its vivid colorful and recognizable badge.

AAS is a high-quality open data source that provides transparency and an abundance of data collected from social media for scholarly publications. In addition to the number of attention counts, Altmetric tracks when, where, and who have made comments about the publication. This feature offers authors and readers an effective way to identify how research results are shared and commented. Robinson-García et al. (2014) studied the AAS of articles indexed in the Web of Science from 2011 to 2013. They identified 16 different social media sources where Altmetric aggregated data from — 95.5% of the total attention count were from Twitter, Mendeley, Facebook, CiteULike, and blog. Costas, Zahedi, and Wouters (2014) analyzed 75,569 publications in science fields, including biomedical and health sciences, life and earth sciences, mathematics and computer, natural sciences and engineering, and social sciences and humanities. They reported that only 15%-24% of the publications were mentioned on social media. Publication topics relate to social sciences, humanities, and medical and life sciences received more attentions than others did. Furthermore, a positive correlation was found between AAS and citation count. Moon et al. (2020) took another approach, they examined 100 articles with the highest AAS in the subject of “Radiology, Nuclear Medicine and Medical Imaging” in the Web of Science, and reported the publication year, journal title, country of origin, article type, subspecialty, topic, and imaging technique of those articles that showcase the public's attention in this subject field.

Thelwall and Nevil (2018), and Wooldridge and King (2019) found that AAS and Mendeley readership were early indicators for predicting future citation count. With the growing acceptance and popularity of social media, more individuals, organizations, and institutions use social media for information sharing and outreach. Authors and readers utilize social media to expand the impact of research results. Meanwhile, attention count of an article receives on social media reflects its influence in the mass population. AAS and Mendeley are considered as alternative methods of evaluating published scholarly articles beyond citation count. In addition, it is notable that most current studies in the scientific fields such as Stroke, Periodontology, and Medicine indicated that AAS can be considered a more-accurate indicator of the public perceptions of research value (Chang, Desai, & Gosain, 2019; Garcovich, Ausina Marquez, & Adobes Martin, 2019; Kim et al., 2019). As we can see, use of altmetrics is a silver bullet, changing academic evaluation by recognizing the increased role that social media has in the academic world. There exists compelling evidence that the measurement of research impact is becoming more robust through use of AAS. However, altmetrics is relatively new in the library and information science (LIS), and libraries as a whole continue to rely primarily on bibliometrics to evaluate the quality of academic materials (Malone & Burke, 2016). With more and more scholars believing that altmetrics should play a larger role in academic evaluation, the influence of altmetrics in the academic landscape is evident. As such, usage of altmetrics in contemporary academia presents an opportunity for the library and information science to invest in development of academic curricula specific to new practices focusing on the measurement of academic impact and its application (Sutton, Miles, & Konkie, 2018).

Objective of the Study

The objective of the study was to employ a multidimensional analysis on the articles published in the top-tier library and information science journals. Relationships between impact factors (AAS, citation count, and Mendeley readership) were analyzed, and reader profiles were characterized and studied as well. To the best of our knowledge, this is the first study that presents the spectrum of AAS and Mendeley readership of the

most cited articles published in top-tier of LIS journals. The research questions drove this study include as follows:

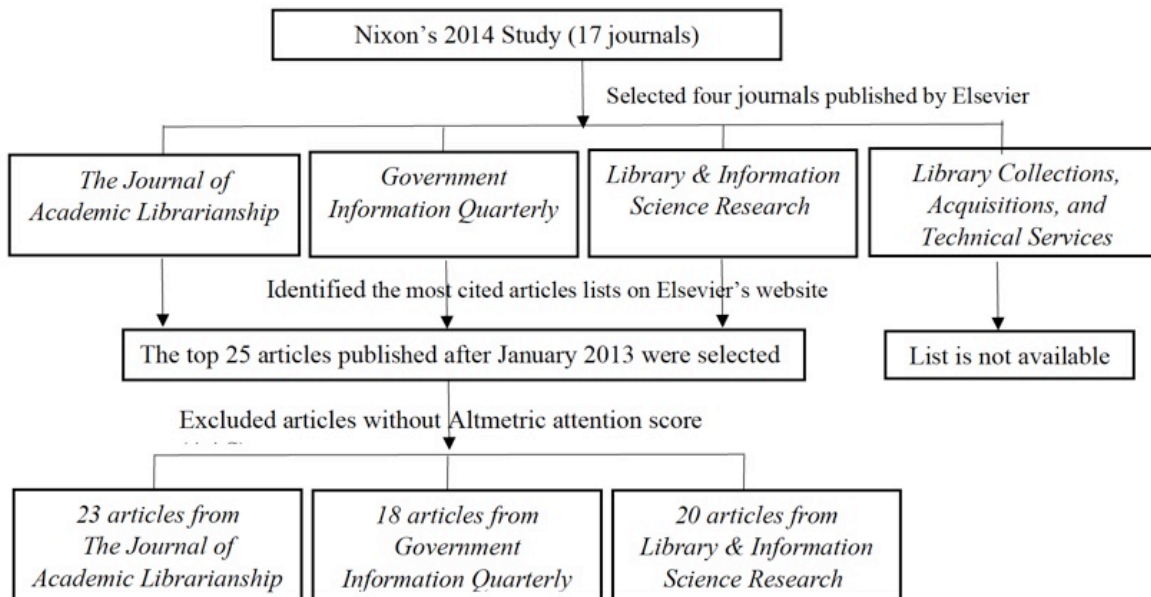
1. In LIS discipline publications, does AAS correlate with citation count?
2. In LIS discipline publications, does Mendeley readership count correlate with citation count?
3. What is the profile of the readers of the most cited articles published in LIS journals?

This study introduces two newly launched metrics for measuring research impact factor and discusses how they correlated with citation metric. Moreover, the study details the spectrum of Altmetric for discovering readership of LIS top-tier journals. The study reveals an alternative way of measuring LIS publication's impact factor that enables researchers, librarians, administrators, publishers, and other stakeholders in library and information science to assess the influence of a publication from another angle.

Method

The tier one LIS journal title list was adopted from Nixon's (2014) study. Seventeen journals were identified based on acceptance and circulation rates, impact factors, h-indexes, literature review, and opinion survey. Four journals occupying 24% of the top-tier LIS journals, were published by Elsevier. Elsevier is a well-known global leader publishing in science, technical and health field with approximately 420K peer-reviewed research articles annually. Elsevier provides lists of the most cited articles for some journals on its website. Three lists of the top 25 cited on Scopus articles published after January 2013 were found for *The Journal of Academic Librarianship*, *Government Information Quarterly*, and *Library & Information Science Research* (see Figure 1). The Altmetric Bookmarklet, a free browser plug in, was employed to collect the AAS and Mendeley readership of each article. Articles without AAS were excluded. A total of 61 articles were selected. Data were recorded on an excel spreadsheet and exported to the statistical software package SPSS 18.0 for Windows to perform the descriptive and correlation analysis.

Figure 1: Data collection procedures



Results

Overview of the three LIS journals

All the articles published after January 2013 had more than eleven citations at the time when data was collected. One article published in *The Journal of Academic Librarianship* titled “Teaching Multimedia Documents to LIS Students” (Krstev & Trtovac, 2014) received the highest citation count (N=192). From high to low, the average citation (See Table 1) and readership counts (See Table 2) of *Government Information Quarterly* were 77.83 and 318.94, followed by *The Journal of Academic Librarianship* (M=30.87 and M=127.9, respectively), and *Library & Information Science Research* (M=22.15 and M=87.20, respectively). Citation and readership of *Government Information Quarterly* was far higher than other two journals.

Table 1: Citation count of the most cited articles in three journals

Journal	Number of Articles	Total Citation	Minimum	Maximum	Mean	Std. Deviation
The Journal of Academic Librarianship	23	710	16	192	30.87	35.99
Government Information Quarterly	18	1401	47	145	77.83	30.57
Library & Information Science Research	20	443	11	53	22.15	13.05

Table 2: Medenley readership of the most cited articles in three journals

Journal	Number of Articles	Total Readership	Minimum	Maximum	Mean	Std. Deviation
The Journal of Academic Librarianship	23	2942	22	318	127.91	72.66
Government Information Quarterly	18	5741	205	471	318.94	93.18
Library & Information Science Research	20	1744	29	290	87.20	57.89

Out the social media platforms observed, articles from all three journals appeared the most on Mendeley and Twitter. The readership of *Government Information Quarterly* was 5,741, which is 1.95 times more than *The Journal of Academic Librarianship* (N=2942), and 3.29 times more than *Library & Information Science Research* (N=1744), and articles in *The Journal of Academic Librarianship* received 204 tweets, followed by *Library & Information Science Research*, and *Government Information Quarterly* which received 128 and 118 tweets respectively. Although tweets were ten time less than reader counts, tweets were still significantly higher than other sources. All three journals showed a total of 23 Facebook posts and 22 CiteULike posts. The total presence of metrics across publications on Facebook, blog, news, CiteULike, Policy Source, Wiki, Google+, and Peer View Site were very low (See Table 3).

Table 3: Social media attentions and citation of the most cited articles since 2013

Attention/Citation	The Journal of Academic Librarianship (Total Article Number =23)	Government Information Quarterly (Total Article Number=18)	Library & Information Science Research (Total Article Number=20)	Total
Tweeter	204	118	128	450
Facebook	6	2	15	23
Blog	8	0	2	10
News	1	0	0	1
CiteULike	7	5	10	22
Policy Source	2	4	1	7
Wiki	1	1	2	4
Google+	0	1	2	3
Peer view	0	0	1	1
Readers on Mendeley	2942	5741	1744	10427
Citations on Scopus	715	1401	443	2559

Correlations between AAS, Twitter, Mendeley readership, and Citation count

To answer research questions one and two, Spearman correlation analysis was used to calculate the correlations between AAS, Twitter, citation, and Mendeley readership count for each journal. Results showed positive correlations between Mendeley readership count and citation count of all three journals. Both *Library & Information Science Research* ($r=.716$, $p<.01$), and *Government Information Quarterly* ($r=.624$, $p<.01$) showed strong and significant correlation. However, the correlation variables of *The Journal of Academic Librarianship* ($r=.217$) was relatively weak. A weak uphill relationship was found between AAS and citation count for *Library & Information Science Research* ($r=.403$), *Government Information Quarterly* ($r=.243$), and *The Journal of Academic Librarianship* ($r=.044$). Results indicated that the correlation of Mendeley readership and citation count, as well as, correlation of AAS and citation count of *The Journal of Academic Librarianship* were weaker than the other two journals. This is attributed to the fact that a few articles did not gain much attention on social media but received extremely high number of citations. This pilot study collected 23 articles in the journal, with such a small sample size, likelihood bias of the result increased.

A positive correlation was found between AAS and Mendeley readership for *The Journal of Academic Librarianship* ($r=.022$), and *Government Information Quarterly* ($r=.357$), while a moderate and significant

correlation was found for *Library & Information Science Research* ($r=.467$, $p<.05$). The correlations between AAS and Twitter were significant and substantial for all three journals (See Table 4).

Table 4: Spearman correlation between AAS, Twitter, citation count, and Mendeley readership

Journal	Spearman	AAS	Twitters	Citation on Scopus	Mendeley readership
The Journal of Academic Librarianship	AAS	1.000	.724**	0.044	0.022
	Twitters		1.000	-0.220	0.087
	Citation on Scopus			1.000	0.217
	Mendeley readership				1.000
Government Information Quarterly	AAS	1.000	.992**	0.243	0.357
	Twitters		1.000	0.214	0.328
	Citation on Scopus			1.000	.624**
	Mendeley readership				1.000
Library & Information Science Research	AAS	1.000	.767**	0.403	.467*
	Twitters		1.000	0.215	0.302
	Citation on Scopus			1.000	.716**
	Mendeley readership				1.000

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Mendeley readers' occupation and discipline

To answer research question three regarding readers' professional backgrounds, the results revealed that librarians (41.7%) were the major readers of *The Journal of Academic Librarianship*, then master students (13.0%). PhD students (35.7%) and master students (24.4%) were the primary readers of *Government Information Quarterly*. The pattern of readers of *Library & Information Science Research* was Master student (26.1%), PhD student (12.4%), and librarian (11.1%). It is noteworthy the most cited articles published in *Government Information Quarterly* were not read by librarians (See Table 5).

Table 5: Distribution of readers' Occupations

Occupation	<i>The Journal of Academic Librarianship</i> (Total reader number=2942)	<i>Government Information Quarterly</i> (Total reader number=5741)	<i>Library & Information Science Research</i> (Total reader number=1744)
Librarian	41.7%	0.0%	11.1%
PhD Student	9.6%	35.7%	12.4%
Postgraduate Student	1.2%	0.0%	6.3%
Master Student	13.0%	24.4%	26.1%
Bachelor Student	5.3%	2.3%	1.1%
Researcher	2.0%	8.1%	2.4%
Professor	0.9%	2.0%	0.1%
Lecturer	0.5%	1.0%	1.2%
Other	25.9%	26.6%	39.2%

Analysis regarding the disciplines of the readers yielded a similar pattern for *The Journal of Academic Librarianship* and *Library & Information Science Research*. More than 35% of the readers were in social sciences, around 16% of readers were in computer science, and followed by arts and humanities, held 12.7% and 7.9% of the population respectively. A different pattern was found in *Government Information Quarterly*. Approximately 31% readers were from computer science, 27% were from social sciences, and 20% were from business, management and accounting (See Table 6).

Table 6: Distribution of readers' disciplines

Discipline	The Journal of Academic Librarianship (Total reader number=2942)	Government Information Quarterly (Total reader number=5741)	Library & Information Science Research (Total reader number=1744)
Social Sciences	38.4%	26.9%	35.6%
Computer Science	15.6%	30.5%	16.1%
Arts and Humanities	12.7%	0.9%	7.9%
Business, Management and Accounting	3.6%	20.0%	3.4%
Philosophy	0.1%	0.0%	0.0%
Nursing & Health Profession	0.2%	0.0%	0.1%
Linguistics	0.3%	0.0%	0.1%
Psychology	0.3%	0.0%	0.9%
Design	0.8%	0.0%	0.0%
Engineering	2.1%	1.9%	0.9%
Agricultural and Biological Sciences	1.0%	0.0%	0.0%
Medicine and Dentistry	0.2%	0.0%	0.6%
Economics, econometrics, and finance	0.0%	2.1%	0.0%
Pharmacology, Toxicology and Pharmaceutical Science	0.0%	0.0%	0.1%
Unspecified	3.9%	7.5%	4.1%
Other	20.8%	10.2%	30.2%

Discussion

The results of this study indicate that Mendeley readership can be considered as a supplemental impact indicator for LIS research publications in addition to citation count. The conclusion comes from two folds. First, correlation analyses revealed that Mendeley readership and citation have positive and significant relationships. Results also indicate that reading and citing behavior are associated. The results consist with Bar-Ilan et al. (2012), and Zahedi, Costas, and Wouters's (2014) findings for various disciplines such as engineering and technology, medicine, social science, chemistry, and physics. The study also exhibits a positive but weak correlation between AAS and citation count. The findings echo with Patel, Vaduganathan, Bhatt, and Bonow's (2018) research on cardiovascular journals. AAS weights sources from websites and social media differently. For instance, information from news scores eight points, while a tweet counts for one point. It is worth mentioning; the score excludes information from Mendeley readership and CiteULike because the sources lack of full details regarding who was referencing (Altmetric, 2016). Results show that a few posts found on news for LIS journals, while Twitter is the most active platform for distributing and sharing research works. A significant number of tweets can contribute to a higher AAS. Therefore, a strong and positive correlation was found between AAS and Twitter.

This study exhibits a stronger correlation between Mendeley readership and citation than AAS and citation. Mendeley is an academic social network platform, in which researchers can organize their works and collaborate with peers. Hence the majority of users on Mendeley are from academia. Those users are more likely to cite and publish papers. While AAS gathers attention from users on social media. This population is diverse and many of them do not conduct research.

Therefore, Mendeley readership is likely reflects academic influence more than social influence compare with AAS. Nevertheless, to a certain extent, social attention has an indirect contribution to academic impact and citation count.

Second, results show that the ratio of Mendeley readership to citation count of three journals range from 3.93 to 4.14. These readers may either in the process of writing and publishing or just a reader. Mendeley readership statistics revealed a considerable part of readers of *The Journal of Academic Librarianship* and *Library & Information Science Research* were librarians. Librarians working in public libraries, academic libraries, and special libraries have different job responsibilities. In general, only librarians with a faculty tenure track status at an academic library require publishing for the purpose of tenure and promotion. Schloegl and Stock (2004), Armbruster (2008), and Mohammadi et al. (2015) reported that librarians are the primary readers of library and information science, and social science publications. Citation-based evaluation of research impact is a fundamental and traditional method across all disciplines in old days without technology support. However, it does not represent a wide spectrum of academic and research impacts (i.e. quality, popularity, and reputation) very well. Mendeley readership could be a useful way for evaluating the merits of LIS discipline publications. In particular, for articles that are newly published.

Moreover, data showed that no librarians read *Government Information Quarterly*. *Government Information Quarterly* is a journal that studies policies, practices, and information technology regarding government information and services (Janowski & Janssen, nd). Nixon (2014) considered it as a prestige sub-discipline journal, even though it was not in other previous studies (Blake, 1996; Kohl & Davis, 1985; Nisonger & Davis, 2005). The journal is not a preferred publication for librarians, because the journal scope is not quite relevant to library and information science. Data also showed that more readers of this journal specialized in computer science rather than social science, as opposed to other two LIS journals.

Beside librarian readers, PhD students, postgraduate students, and master students in combination possessed a large reader population on Mendeley. The similar readership pattern was found in Mohammadi et al.'s (2015) study. Mendeley is a reference management tool that allows users to organize references, to store and share data, and to connect with peers. This innovative system of managing reference, as well as its social

networking component attracts young researchers more than senior ones. Senior researchers have low self-efficacy on learning new tools and technologies, and they tend to use their familiar referencing practices. Young researchers are also reported to read more publications than experienced researchers do (Barnett & Fink, 2008) as they need more sources and ideas for generating a research topic. Moreover, often the literature they found were not relevant to the study they are working on due to lack of research experience. In addition, the population in Mendeley is in the learning stage of conducting theses, dissertations, and research assignments. The above reasons made them become dominant readers on Mendeley.

Conclusion and Future Studies

In summary, using AAS and Mendeley readership to evaluate the impact of a publication have the following advantages:

1. Providing real-time reflection of a publication's impact via number of attention.
2. Providing transparent and traceable data.
3. Harvesting comprehensive data from multiple channels including Twitter, Facebook, blog, news, etc.
4. Representing a broad range of readers from public access to peers and researchers.
5. Correlating with citation count in differing degrees.

In addition, this study gives a snapshot of Mendeley readership profile for the most cited articles published in the top tier LIS journals since 2013. However, readers' profile on Twitter and Facebook have not yet been investigated. For future studies, Twitter users' profile is a worthy observation because tweets are greatly associated with AAS. Previous studies regarding social and academic impact of Twitter and Facebook yielded divergent results. Maricato and Filho (2018) found that academic impact is higher than social impact in the health sciences, agriculture sciences, biological sciences, and humanities, while applied social science showed opposite result. Sankar (2015) studied Twitter users' profile found that four Nature journals have a

higher social impact than academic impact. Social and academic impact of a publication on Social web vary from discipline to discipline.

According to SCImago's ranking of academic journals, articles in biomedical sciences are highly referenced. Those journals are considered prestigious journals because of their high citation count. However, citation count of articles published in soft sciences are far lower than those hard science journals. Citation count could overlook the value of a publication brings to individuals who are not researchers. As such, Altmetric and Mendeley could presents a positive value of a publication has beyond citation count because social media greatly enhance visibility of research results and promotes outreach and engagement. To extend our understanding and to better use Altmetric and Mendeley data to indicate journal publications' impact, a future prospective study is required. For instance, researchers could examine the occupational background and disciplinary field of individuals who tweet and retweet publications on Twitter to identify how much social impact Twitter has in the LIS field publication. If social impact finds to be greater than academic impact, then it indicates that publications on LIS are more likely generalized use in daily practices. It can further confirm that in the area of LIS, citation count may not comprehensively represent the value of a publication.

Moreover, because data from Altmetric is transparent and traceable, future research can explore different facets of Altmetric. For instance, what formats (e.g. image, video, link, text etc.) and contents (e.g. abstract, highlight, review etc.) receive more attention and retweets? When and where does a "first post" usually appear, and who usually writes it? How long does the article stay relevant? The answers to these questions help researchers and publishers create a more robust understanding of people's searching and researching behaviors. In doing so, researchers and publishers can utilize metrics to increase awareness of their scholarly works—capitalizing on the ways that contemporary knowledge is disseminated in the digital world.

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