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Essay

Scientific communication in the 21st century: Tweeting, Facebook Likes, and everything in-between

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Introduction

Science has always been about two fundamental goals: understanding our natural surroundings and using the acquired understanding to improve the quality of life of everyone in society. Given this relationship, everyone in society is a key stakeholder of all scientific endeavors. However, the dissemination of key research findings has arguably been restricted to exclusive groups of scientists with few attempts at educating and engaging the general society on research outcomes. True public engagement requires one to think beyond the traditional paradigms of research publication. While the traditional journal article serves the purpose of taking science forward one step at a time, there is an increasing need for new wider research dissemination platforms and new research content formats that are easy to digest and engage stakeholders beyond the academic and scientific community.

Science communication and engagement are no longer restricted to a specific community but are instead now expected to target the public to engage funders, policy makers, and society at large. This changing landscape is affecting the way publishers and authors are thinking about scientific engagement. It is resulting in the adoption of newer platforms for research dissemination, developing newer research content formats, and supplementing traditional research impact measurement metrics with newer ones.

How Can We Achieve Public Scientific Engagement?

Traditional research articles have been the cornerstone of all research dissemination over print and online journals. Owing to the nature of the content and distribution channels, these articles have always focused on engaging an audience that was restricted to academia or had specific interests in certain research domains.

Studying the history and evolution of the scientific journal reveals that traditional research articles published in journals cannot be used as a tool for public engagement [1].

We need to first explore the possibility of research dissemination platforms and new research content formats as the basic building blocks for public engagement beyond traditional

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article formats (e.g., full text articles, essays, reviews, critiques, etc.) and journals. Increasingly, newer content formats (e.g., research video summaries, infographics, layman summaries, etc.) and dissemination platforms (e.g., Twitter, blogs, science news websites, etc.) are being adopted to better share science with a larger audience. These newer content formats are adapting to the dissemination platforms and audience engagement behaviors. Therefore, we are stepping into an era where the dissemination platform and its audience dictates the format of science communication.

Science communication is now essentially becoming goal oriented: 1) Science communication for peers and archiving continue to be via the traditional journal article format through online and print journals as the primary channels for dissemination. 2) Science communication for the public through content formats that vary depending on the platforms deployed for research engagement.

Changing Face of Scientific Communication: Content Formats and Impact Measurement

We note how science communication for public engagement has begun to change with the adoption of newer dissemination platforms and content formats.

To understand the changes in science communication, we need to first understand the incentive to adopt these dissemination platforms and content formats for the primary drivers of scientific progress and communication, namely, publishers and researchers.

Increasingly, research has become competitive with an exponential increase in the number of journals and researchers for every discipline. Some estimate that the global research output doubles every nine years [2]. Over time, this increase in research output leads to an information overload problem for readers like researchers across all scientific disciplines. This problem is even more exacerbated for people that are not directly related to research.

This information overload has clearly increased the need for scientific content discoverability as a focus for publishers and researchers.

The focus has now begun to shift from traditional content formats such as online/offline journals to content formats (video, audio, layman summaries, etc.) that are engaging and tailored for increasingly alternative dissemination platforms beyond traditional journals.

As these newer content formats and dissemination platforms take root, there has also been an increasing need to measure research impact for these newer content formats and dissemination platforms. For the longest time, citation rates and impact factor have arguably been considered as reliable proxies to measure research impact for a research manuscript and journal, respectively. However, over the current decade, we have seen the rise of Altmetrics and its purported metric Altmetric Attention Score (AAS) emerge as a reliable measure of research impact. As we understand AAS better, it becomes clear that it is a measure of research impact with a positive but weak correlation [3] to citation scores. Therefore, as AAS becomes more widely accepted as a complementary metric of research impact that has a positive correlation to citation rates, it is evident that research dissemination platforms and the impact that AAS measures are evolving with increasing adoption. Thus, it merits further investigation through its evolution. This evolution of AAS significance for research impact measurement will be closely related to the evolving content formats used to effectively influence each of the AAS metrics (Table 1) [4].

Table 1. The weightage of each research dissemination platform contributing to a research article's Altmetric Attention Score

Media stream	Weights per mention
News media	8
Blogs	5
Wikipedia	3
Policy documents	3
Twitter	1
F1000/Publons/ Pubpeer	1
Open Syllabus	1
Google+	1
Facebook	0.25
YouTube	0.25
Reddit	0.25

Thus, it is intuitively evident that new impact measurements metrics emerging in tandem with new research content dissemination platforms will lead to new customized research content formats. We can now firmly say that we are witnessing the evolution of research content communication driven by the adoption of newer content sharing platforms and related content formats, leading to new impact measurement metrics. The face of science communication is changing!

How Can Publishers and Authors Adapt to This Changing Scenario?

It is clear that we are amidst a changing reality where research dissemination platforms are diversifying, resulting in newer research content formats and measurement metrics.

New content formats

Along with newer research content dissemination channels, it is observed that newer research content formats that are adapted to these channels are also gaining in popularity. We will briefly review these content formats below:

Visual summaries present key results in a snapshot, providing an at-a-glance summary. They require minimum time burden and have high recall values and can also be used as presentations. The variants of this format include infographics, graphical abstracts, and visual abstracts.

Video summaries bring the research to life with audio, graphics and animation. They have a high outreach potential because of an engaging format and are particularly helpful for a show-and-tell approach. The variants of this format include video summaries, figure explainers, and talking head videos.

Audio summaries present portable contents which listners learn on-the-go. They build a community of listners and share opinions and commentary on a critical topic. The variants of this format include podcasts, audio slides, and interviews.

Lay summaries present alternatives to abstracts that are accessible to a more general audience. They are more taylored for coverage on mainstream science media and easiest to convey research impact. The variants of this format include plain-language summaries, blog posts, news stories, and press relaeases.

AAS as a complementary research impact metric to citation rates

For simplicity, we will restrict the overview of newer research platforms for research sharing to the ones measured by AAS (Table 1), since this currently accounts for the most comprehensive type of research dissemination platforms in terms of its research impact measurement assessments [4].

Case studies for alternative research dissemination channels and metrics

Publishers have started experimenting by accommodating these newer content formats to facilitate better research content dissemination; this is seen in some of the below mentioned experiments.

Annals of Surgery conducted the study presented in Fig. 1 to quantify the impact of content formats (Visual Abstract VS Title only) on article reads for Twitter [5]. Articles with a visual abstract were read nearly three times more than those that did not have a visual abstract.

Cell Press experimented with Figure360. These are talking figure videos embedded within manuscripts that replicate a conference presentation. These products were embedded in an article PDF as seen in Fig. 2. The key metric that Cell Press measured was "Do users perceive a high level of value in F360 videos?" Over 60% of the respondents responded positively. This was concluded as a successful experiment.

Annals of Laboratory Medicine conducted a short-term trial where they experimented with alternative article formats (video or infographics) alongside traditional formats of published articles. They found that those with alternative formats were cited nine times more than regular articles.

Journal of Bone & Joint Surgery began permitting alternate formats alongside articles (Fig. 3). The articles with these content formats performed much better than the articles without these, achieving 4-10X more social media views and interactions for posts with visual content.

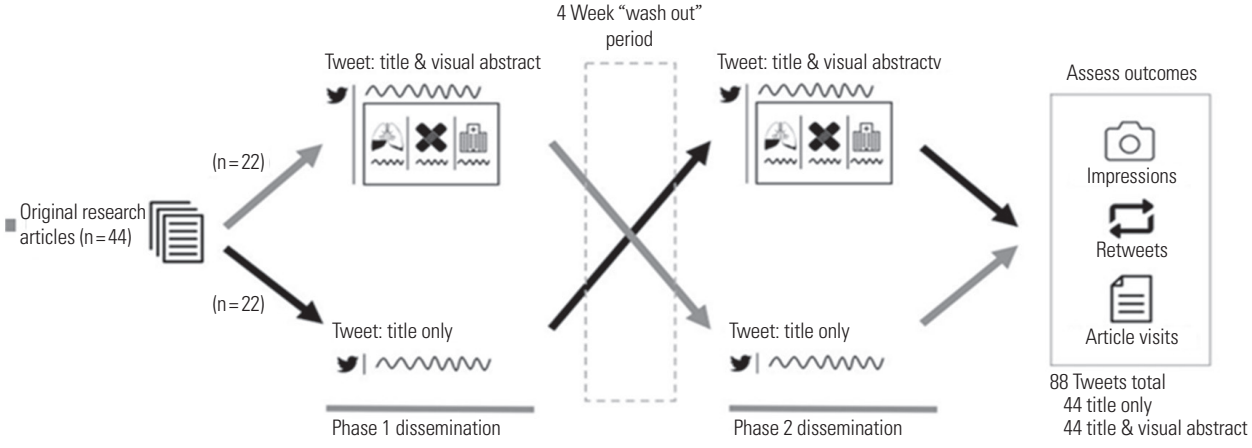

Fig. 1. Study design. Prospective, case-control crossover study to evaluate the impact of visual abstracts on Twitter. Study conducted between July 2016 and December 2016 using articles published the same year. All articles in this study were tweeted from Annals of Surgery account (Twitter: @AnnalsOfSurgery). Outcomes data were aggregated from Twitter Analytics and compared using matched-pair t-test analytics. Reproduced from Ibrahim AM, et al. Ann Surg 2017;266:e46-8, with permission from Wolters Kluwer Health [5].

One specific study showed that AAS in ornithology was a good predictor of future citations in lower impact factor journals [4]. For higher impact factor journals though, this correlation was weaker since higher impact factor journals were anyway highly circulated/read, leading to higher citation rates. This interplay of impact factor, probability of citation, and AAS is seen in Fig. 4 [4].

Another study on ecological research showed that though articles in high impact factor journals tend to be heavily cited [6], those in lower impact factor journals can also be heavily cited when they generate significant Twitter activity (also reflected in AAS scores).

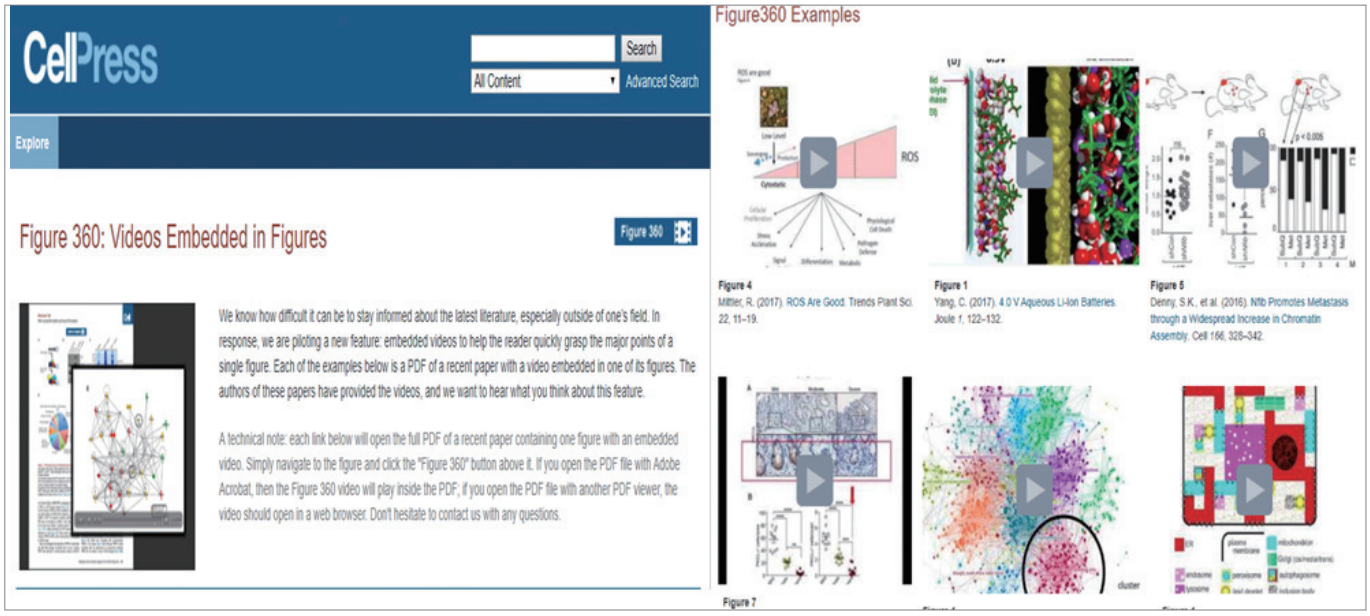

Fig. 2. Cell Press experimenting with Figure360 as an innovative 3D video embedded in figures (https://www.cell.com/figure360).

Fig. 3. Alternative content formats (indicated by the red square box) integrated with existing ones in *Journal of Bone & Joint Surgery* (https://journals.lww.com/jbjsjournal/Abstract/2018/03210/Clinical_Outcomes_Following_the_Latarjet_Procedure.2.aspx).

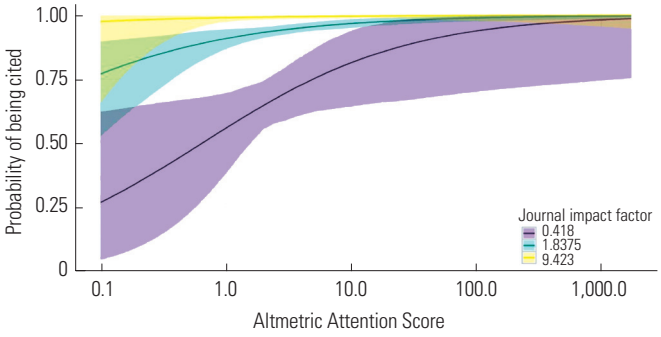

Fig. 4. Relationship between Altmetric Attention Score, journal impact factor, and probability of being cited. Lines show predicted citation probability ±95% confidence interval for journal impact factors of 0.418 (minimum), 1.838 (median) and 9.423 (maximum). Note: log-transformed axes.

These cases show a definite shift in some of the newer research content formats that are being adopted, platforms they are being shared on, and the increasing research and experiments being conducted by both authors and publishers on the future and correlation of these changes with traditional research content sharing platforms and content formats.

Conclusion

With the rapid increase in global scientific output [2] and competing research, the need to draw attention to published scientific articles and make them noticeable is rapidly becoming the need for both journals and authors. To do so, it is important to look at research sharing platforms and impact measurement beyond traditional ones such as journals and citation metrics, respectively. Social media platforms are fast gaining popularity for both sharing and consumption of scientific research output. AAS scores are rapidly being accepted as a means of measuring the research impact of scientific output published in social media. These developments, coupled with increasing research on discipline-specific positive correlation of citation rates and AAS [3,4,6], mean that the evolving trends of disseminating and measuring the impact of scientific articles will only continue; these trends will need continuous research so that their potential is fully explored from a societal impact perspective. As these trends evolve, scientific research content formats need to evolve from traditional journal articles to newer formats like visual, video, audio, and lay summaries to better leverage the new research dissemination and measurement trends that are gradually being adopted by the larger academic and scientific community.

Conflict of Interest

The author is business head for Editage Korea which is an editorial and research communication service provider for publishers and universities. No other potential conflicts of interest relevant to this article is reported.

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