New Orleans JAZZED about Engineering Education

Paper ID #14559

Using Altmetrics as an Engineering Faculty Outreach Tool

Prof. Megan R Sapp Nelson, Purdue University, West Lafayette

Megan Sapp Nelson is Associate Professor of library sciences at Purdue University Siegesmund Engineering Library. She serves as a liaison to Civil Engineering and related departments in the schools of Engineering, Technology, and Science.

Using altmetrics as an engineering faculty outreach tool

Abstract

Engineering faculty members are increasingly looking at the pros and cons of the number of research communication tools that are available but are overwhelmed by the variety and lack of evidence that the tools will have a positive influence on research impact, promotion, and tenure. Engineering faculty are drawn to altmetrics for a more complete picture of real world impact while simultaneously dubious of the validity of these emerging measures. This paper reviews the literature on altmetric tools, identifies the existing tools, as well as pros and cons of using those tools. The author investigates how the tools can be used to create an outreach service for faculty members in engineering that supports disciplinary faculty to strategically design an online presence for research impact.

Introduction

Where researchers have looked to traditional journal based metrics in the past as an indication of the impact of their scholarly work, increasingly print presents limited information about the much more dynamic environments of internet based communication platforms such as Twitter, networking sites such as LinkedIn and ResearchGate, or even aggregators such as Google Scholar.[1] In the past ten years researchers have had alternative means to publicize their research using social media and other web based tools. A category of tools that measure impacts and statistics of usage and viewing based on the Social Web are referred to as altmetrics.[2] Altmetrics present an alternative to journal based metrics such as impact factor, Eigenvalues, and other print based algorithms or measures.[3]

The basic functions of online scientific communication via the social web include collaboration, searching for relevant content, documenting original materials, promoting one's work, building peer networks, extracting and organizing information, and conducting peer reviews.[4,5] Scientific and professional communication online supports diversity in the sciences and engineering. It provides a platform for role models from diverse backgrounds to connect with new scientists and engineers.[6] Online scientific communication also allows individuals in specialized areas dispersed over a wide geographic area to easily communicate as a discipline in a designated virtual environment.[4] It gives a venue for identifying and/or purchasing parts, information on user opinions or demographic information, and competitor information.[7] Social media can also enable geographically dispersed design teams to complete projects using asynchronous and synchronous communication.[8]

Taking advantage of these functions requires scientists and engineers to communicate strategically. The variety of social web tools available each offer different functions and utilities.[4] Similarly, different altmetric tools measure the impact of different social web tools. Just as liaison librarians presented faculty members with journal based metrics and helped them to frame their impact for promotion and tenure cases, liaisons can also assist professors to understand the emerging social web and available article level altmetrics to strategically choose how to disseminate their scholarly work in a way designed to maximize impact within the social network landscape. This article focuses on the information necessary for a librarian to successfully create this outreach.

Review of Literature

Altmetrics emerged out of a recognized need for a new way to represent research impact, including all discussions of an article.[9] It was evident as early as 2005 that citations to scholarly information in print and on the web were not equivalent.[10] Early work wrestled with the distinctions between terminology (netometrics vs. webometrics), between links to articles versus web based citations, and to identify the units of analysis that would be included in the emerging field.[11] In 2010, Priem, Taborelli, Groth and Neylon issued a seminal document in the development of altmetrics. Referred to as the Manifesto, the document called for a new way to sort through the scholarly literature on the web and prioritize that literature that would be worthy of limited time and attention. Altmetrics were proposed as the new alternative to traditional methods because they allow crowd-sourced peer review and a much quicker time to the beginning of public comment on scholarship.[2]

With Web 2.0, the emerging field of altmetrics integrated the new social media landscape into the fields that sought to quantify scientific impact on the web. Emerging social media platforms presented an alternative to traditional biblometrics with a major advantage, that of a much quicker impact measure.[12] This boosted current awareness efforts by enabling researchers to identify influential articles shortly after publication, rather than months or years after publication (as in the case of journal article citations.) Additionally, altmetrics provided an advantage in that they allowed faculty members to identify impact in the increasingly interdisciplinary academic environment that emerged along with the advent of social media enabled communications.[13] This broke down the siloed nature of academic publishing and allowed faculty members to identify both their impact outside their discipline and potential collaborators for interdisciplinary research (highly valuable information that is difficult to locate in other ways). Altmetrics also provided researchers a way to demonstrate to granting agencies that their projects are achieving broad reach to the general public, something that is increasingly mandated in calls for proposal.[14]

Altmetrics measure a variety of different interactions with content. Those interactions may include somewhat passive interactions, such as a page view, a like on Facebook or a favorite on Twitter. The interaction may require more critical thinking and evidence of engagement with the materials, as in the case of comments on a publisher website (PLOS encourages post publication peer review on online forums on the publisher's website) or taking notes on a citation in Mendeley. There is also a middle ground, in which an information consumer "adopts" information in some way as their own. Connotea, CiteULike, GitHub Forks, Shares on YouTube or Facebook and requests for papers on ResearchGate or Academia.edu occupy this space.[15]

Priem, Piwowar, and Hemminger established that there are currently five patterns of usage of scholarly works on Web 2.0 enabled sites: "(1) highly rated by experts and highly cited; (2) highly cited, highly shared; (3) highly bookmarked, but rarely cited (4) highly shared, but rarely cited; and (5) rarely shared, bookmarked or cited".[3,6] Given this, there is a broad range of likely outcomes for information that is shared on the web. The selection of a carefully chosen communication strategy for a specific type of information appears to be logical and potentially necessary in this emerging environment.

Because altmetrics is a relatively new area of bibliometrics, there is a rapidly growing literature expressing concern around the validity of these measures. Research continues to determine which metrics hold the most promise for long term validity. As of 2013, "tweets, Facebook posts, research highlights, blog mentions, mainstream media mentions, and forum posts *associate* with citation counts."[16] [Italics are author's addition for emphasis.] There have been initial investigations done into the validity of altmetrics across a wide array of disciplines with indications that Mendeley is the most consistently correlative source of altmetrics data compared to Twitter, Wikipedia and Delicious.[17] This has been shown across a cluster of papers and is becoming commonly accepted.[18,19] Similar research in which metrics from specific platforms (Mendeley, ResearchGate, Twitter, CiteULike) are compared with traditional sources of bibliometrics (generally Scopus or Web of Science) to establish the presence or absence of correlation between traditional bibliometrics and altmetrics are being performed systematically.[11,12,16,19-23] The Life Sciences post publication peer review site F1000 has been shown to have strong correlations between citations and F1000 article rankings in a cluster of studies.[18]

Generally there is little correlation between cited references and altmetrics.[18,24] This can partially be explained due to the variety of motivations that individuals have for discussing a scientific publication on the social web. While some individuals will be engaging in scholarly communication, some comments will be humorous and some will be for personal research or interest that has nothing to do with science but that nevertheless catches interest and prompts social sharing.[18] This in turn means that some percentage of the tweets or upvotes or mentions that a scholarly product receives will always be off topic from the scholarly conversation, and will in turn skew the correlation between cited references and the altmetrics.

Many faculty seek assurances of quality from both social media tools and altmetrics and many are discouraged from using these tools due to the absence of formal peer review.[4] Barnes has identified major problems with the analysis done on many studies of altmetrics. Her paper highlights that many studies have problems with reporting the size of the correlations of statistical significance, misuse Pearson's correlation coefficient in the statistical analysis, exclude articles that have no mentions on the social web from their samples, thereby increasing correlations, and compare altmetrics with citations based upon an inference that altmetrics will predict citations (when that inference is in doubt).[18] Additionally attribution is a major concern. Sharing findings online without a way of permanently attaching authorship to those findings (i.e. traceability in software sharing or provenance in other types of information sharing) is a source of delayed acceptance for online social media tools and altmetrics.[4]

Strategically Designing an Online Presence for Research Impact – An Outreach to Faculty

The use of altmetrics as an outreach to faculty members is emerging in the literature. Galligan was among the first to identify a scholarly communication outreach possibility for librarians by highlighting the idea of assisting faculty members to demonstrate research value through a deliberate strategy of scholarly communication.[14] Barbaro, Gentili and Rebuffi perceived the primary library roles as educating faculty about the latest altmetric tools to emerge and encouraging experiments in new uses of those tools.[25] Galloway, Pease and Rauh suggested

outreach to faculty using altmetrics in their article comparing traditional scholarly metrics and altmetrics.[26] Adams and Bullard went a step further and created a short course in Social Media enabled scientific communication for conservation biologists that included altmetrics.[27] This course provided basic information on existing altmetric tools at the time the course was offered as well as collaboration tools and open access scholarly communication. However, the course did not identify which tools would maximize impact using altmetrics.

Moving beyond these existing ideas, academic librarians are in the position to tailor the message about these emerging altmetric tools in the best way to be meaningful to their disciplinary faculty members.[28,29] This requires both an understanding of the faculty members, the discipline as a whole as well as the tools that are available. Packaging a social networking profile with altmetric functions for the purpose of raising professional profile or supporting a promotion and tenure case may prove to be a compelling use case.[30] Similarly, identifying altmetric functions that increase the efficiency of faculty in teaching roles or enable faculty to more efficiently identify emerging trends in a research discipline could be a valued added service that is currently buried in the data within altmetrics.[31] Similarly, helping faculty to recognize the potential of altmetrics for identifying interdisciplinary research partners based on interests that overlap is a value added service, particularly in an era where interdisciplinary research is prized by funding agencies.[13] For these reasons and more, a strategically designed altmetric outreach to faculty represents a new, potentially valuable service. But what does that service actually look like?

Faculty and universities are looking for the largest demonstrable impact on the web to get the word out about the scholarly research that they have performed.[32] Therefore as librarians, liaisons have a unique opportunity to help faculty to tailor their energy and time usage based upon their personal goals. This outreach in strategically designing an online presence for research impact gives librarians the opportunity to have an in-depth discussion with faculty members regarding their research dissemination goals. Librarians can then provide advice upon the dissemination routes that have corresponding altmetrics that can demonstrate the impact of the faculty members' alternative scholarly communication efforts.

The current landscape of Altmetric tools

The first step to the development of this outreach for librarians is to become very familiar with the currently available tools and their corresponding metrics. This article contains a list of altmetric tools current as of March 2016 in Table 1. Additionally, a full comparison chart of the capabilities of the available tools is available.[33] However, the altmetric market is a rapidly changing one and this print article you are reading will be out of date within one – two years of publication (at a conservative estimate). As the author was writing this article, three separate altmetric services that had existed within the last three years but were no longer supported were identified on library websites being advertised as available. These services were ScienceCard, Crowdometer, and ReaderMeter. All were developed and disappeared since 2012. This just goes to show the rapidly changing nature of the altmetric tool market and the need for liaisons to stay aware of the altmetric tools available at the time of the liaisons' altmetric outreach.

Due to the shifting altmetric landscape, some of the best places to find information on current altmetrics tools include Twitter, Figshare and Mendeley, social media platforms that feature altmetrics integration. Blog posts frequently bring new altmetric features and tools to the public. This is one area where traditional journal articles, while valuable, are demonstrably slow.

If a liaison does want to keep up on the latest academic research in altmetrics, the journal *Scientometrics* is consistently publishing the highest quality scholarly content testing the validity of emerging altmetric tools. Mike Thelwall and his research lab [11,12,16,20] as well as several other small research groups that are carrying out systematic critical analysis of altmetric tools in comparison with traditional bibliometrics are consistently publishing their findings in *Scientometrics.* It's a worthy addition to liaisons' current awareness protocol.

Selecting online scholarly communication venues

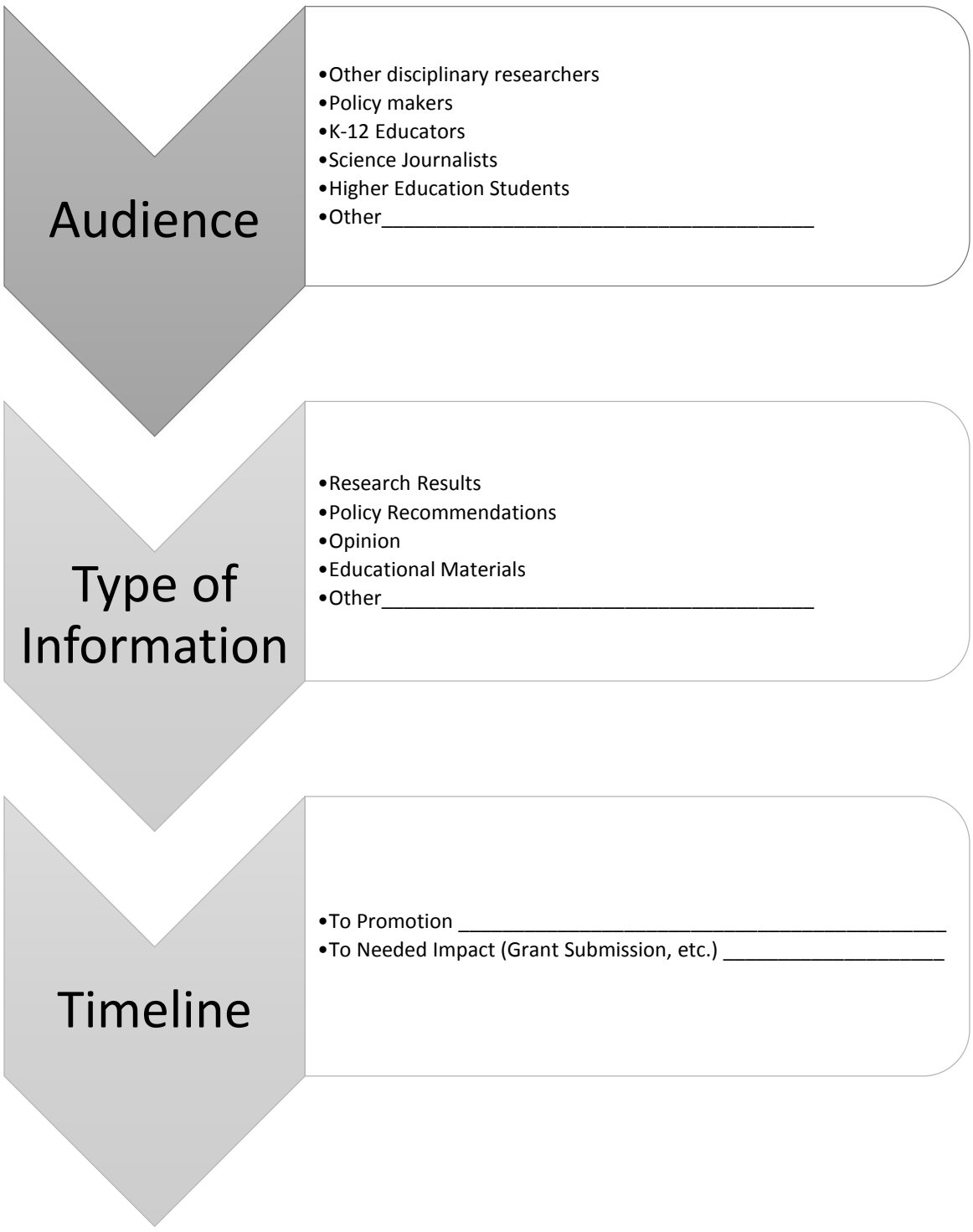
The next step is helping faculty members to identify their own rationale for using alternative scholarly communication venues. Figure 1 below shows an example handout that a librarian may consider using to assist a faculty member to think through their research dissemination goals. It is important that the faculty member articulate what scholarly products will be disseminated through the web environment and will therefore be the subject of the impact measure.[14] Many times the altmetric tools produce subjective measurements that will need to be interpreted in light of the product the faculty member wishes to disseminate.

The faculty member needs to be clear on the rationale for each choice made in this process. The consulting process is therefore about educating the faculty member to the point where they can make an educated decision in their own right about the dissemination channel and the altmetric measuring the impact of the scholarly product.

Figure 1 "Determining your research dissemination channels" was developed to facilitate the faculty members reasoning process regarding scholarly communication distribution channels. It highlights the need for the faculty member to consider multiple constraints when selecting an online communication vector. For instance, if the faculty member has only a few months to tenure, demonstrating impact will require proactive dissemination of links to scholarly products through venues where their colleagues are likely to see *and comment* on those products in the short period remaining prior to the submission of the tenure dossier. This may well require a scan of multiple online platforms to determine where impactful researchers in the disciplinary field have online profiles or are active participants. While it may seem that Twitter is an obvious solution in this situation (given the very quick dispersion of a message that it can have, plus the ease of measurement through Altmetric) if the colleagues of the faculty member are not on Twitter, it would be a waste of time and energy to publicize research there. On the other hand, were the faculty member actively seeking out interdisciplinary collaborators, Twitter may be a very reasonable vector of communication.

Figure 1

Determining your research dissemination channels



Matching social media channels to altmetric tools

Matching the dissemination goal of the faculty member with a channel that has an altmetric is challenging because of the variety of channels available. This step requires the librarian to think through the implications of the needs of the faculty member, as well as the pros and cons of the available tools to make a recommendation. Different existing altmetric tools provide analytical measures on differing communication tools.

In Table 1 below the tools are shown along with the related communication channels. Subscription tools are marked with an * An extended table containing the altmetric tools, social media tools captured, target audiences, factors contributing to metric calculations, known validity studies, some suggested ideas for when or how to use the tools in outreach and associated references has been developed in conjunction with this article but is not suitable for a print publication. It is housed at Purdue EPubs and is freely available for download.[33]

Table 1 altmetric tools and the social media channels that they capture

altmetric tool	Social media tools measured by altmetric
Academia.Edu	Internal (Academia.edu) metrics only for uploaded papers. For more information, see http://support.academia.edu/customer/en/portal/topics/575525-analytics/articles
AltMetric	Article level metrics with 23 different impacts. Tracks Twitter, Facebook, Google+, blogs, CiteULike, Connotea, Mendeley, newspapers, Wikipedia, government policy documents, and other research platforms such as F1000. For more information, see http://www.altmetric.com/blog/metrics-grant-application/
F1000Prime	Article level metrics based upon recommendations internal to F1000. Ranking metrics based upon internal site metrics. For more information, see http://f1000.com/librarians
ImpactStory*	Article level metrics. Tracks Twitter, Facebook, Google+ , arxiv, blogs, CiteULike, CrossRef, Dryad, Figshare, Github, Mendeley, Plosalm, Plosearch, publons, PubMed, Scopus, Slideshare, Vimeo, Webpages, Wikipedia, and Youtube. For more information, see http://feedback.impactstory.org/knowledgebase/articles/367139-what-data-do-you-include-on-profiles
Kudos	Uses AltMetric Service – all altmetrics above. Plus Kudos site specific metrics and publisher download data as well as Web of Science citation metrics. For more information, see https://www.growkudos.com/about/user_guide
PLOS Impact Explorer	Uses AltMetric Service – all altmetrics above plus PLOS publisher and site specific metrics. For more information, see http://www.altmetric.com/demos/plos.html
Publish or Perish	Article level metrics such as H-index, g-index, e-index. For more details see http://www.harzing.com/pop.htm#metrics.

ResearchGate	Article level metrics for website, including view counts, number of citations, and profile views. Also a comparative productivity score called RG Score. For more information, see https://www.researchgate.net/blog/post/your-new-stats-page
Scholarometer	Article level metrics based upon Google Scholar. Universal impact measure and h-index included as well as traditional citation metrics. For more information, see http://scholarometer.indiana.edu/faqs.html#impact-metrics

Additionally, this may be a good point to discuss the metrics that are associated with depositing in your institutional repository. Discussing article level metrics available through a locally based repository provides researchers with another possible venue to host items instead of hosting items on their own website or webpages or placing items in a disciplinary repository that isn't a great fit for the type of material or the intended audience. For institutions with a subscription to Plum Analytics (a service that provides altmetrics for institutional repositories), this is a natural segue into the benefits of hosting materials in an IR. By hosting the materials locally, researchers can use the permanent address for their item to focus on "boosting the signal" of their work in their chosen alternative communication mode.

Regarding time period to impact, if a faculty member has years to prepare for a tenure or promotion case, they have time to build impact with both altmetrics and traditional citation metrics, which is a complete picture of impact with the existing article level metrics, journal level metrics, and alternative metrics. If a faculty member is trying to demonstrate impact in the shorter term, alternative metrics provide an imperfect metric at a shorter time scale. Professors should be aware of the tradeoffs in terms of the validity versus availability for the various metrics that have been developed.

A case study in alternative scholarly communication outreach

This case study was the author's initial foray into a scholarly communication and altmetric outreach. A faculty member created educational materials targeted to K-12 teachers and wanted to get those materials to that audience. The faculty member started the discussion with the author regarding whether it was worth the faculty members' time to start a blog. Blogs are standalone and require constant creation of material, plus additional signal boosting on other social media such as Twitter to aid people to find the page in order to become successful. The author explained this to the faculty member. The faculty member understood that, did not feel that she had adequate time to allot to the blog, and requested additional ideas.

Following the guidelines above, the discussion began with a discussion of audience. The faculty member had a clearly defined audience in mind. She wanted to reach K-12 teachers with her educational materials. The educational materials were short brochures highlighting the results of engineering education research that could be implemented within the K-12 classroom.

The type of information and the format of the material was such that it could be housed in several places, including the university libraries' document repository, appropriate disciplinary

repositories, and the faculty member's own website. Based upon the author's knowledge of the disciplinary repositories and available resources at the institution, the author described each of the options to the faculty member. After discussion of the merits of each option, an online repository (MERLOT) was selected to list the educational materials, which provided an online location that could be accessed by K-12 teachers. This repository is widely known as a location for educational materials and would lend itself to serendipitous discovery of the faculty's materials by K-12 teachers. The university repository was selected to house the materials, which would provide the materials a DOI, an important factor for later altmetric tool selection.

The faculty member and author then strategized appropriate distribution channels that will reach K-12 teachers, while bearing in mind ways to measure impact via altmetrics. One factor in selecting the distribution channel was the matter of timing. The faculty member wished to create an ongoing outreach but particularly wished to focus on the summer months, when K-12 teachers have some time to reflectively consider pedagogical practices. Because time was not a limiting factor, but ongoing relationships were a factor in the strategy, it was clear that a social networking site would have assets that a site such as a microblogging site such as Twitter would not have.

Ultimately, it was determined that LinkedIn would be the best social network to publicize the availability of the tools due to the presence of large K-12 professional networks. LinkedIn is monitored by AltMetric and Kudos, so the altmetric tools available were identified at the same time as the dissemination plan was developed. The faculty member was signed up for a Kudos account, and was shown the altMetric badge. The altmetric badge works for the university repository because individual deposits are assigned a DOI. Therefore, the faculty member had multiple altmetric tools to monitor the impact of the educational materials she was marketing via LinkedIn to the K-12 networks.

With a plan in mind, the faculty member was able to focus on crafting short messages for LinkedIn to catch the eyes of K-12 faculty members and direct them to either MERLOT or the university repository. If someone were to access the files through either place, those downloads would be monitored through Kudos or AltMetric.

Helping faculty think through possible downsides of altmetrics

Faculty members need to be aware that there are critical considerations regarding the use of altmetrics and academic librarians can help them to understand the implications. The fluid nature of social media and the Internet, the rapid turnover of apps and tools, and the rise to prominence and decline in popularity of tools mean that altmetrics don't have a specific, continuous definition (as compared to impact factor, for example, which has an unchanging algorithm.) This changing landscape may present the appearance of inconsistency over the lifespan of a 10-12 year promotion case from assistant to full professor, as different altmetric tools will present the most accurate picture of a disciplinary faculty members' social media influence at different times during that promotion period.[28]

The data that makes up altmetrics can also be manipulated and is manipulated by companies and political candidates on a daily basis. There are companies whose work is to manipulate the

appearance of influence of companies or individuals on a variety of social networks. Faculty members should be aware that the data that these numbers are based upon are not fixed in stone and could be unethically inflated or deflated.[1,13]

Faculty members of under-represented minority backgrounds and who are female should be aware that engagement in social media can bring unwarranted harassment simply because they presented their opinion in an unregulated public space. While most of the faculty members will be aware of this, recognizing that there is a conservative road to promotion and tenure that focuses solely on traditional scholarly publication and that protects the professor in some ways from harassment may be a valid conversation to have with all faculty members.[34]

It may also be valid to have a conversation regarding who the likely audiences are on different platforms. Twitter for instance, skews young and urban while Mendeley skews academic.[19,35] Depending upon the desired outcome for the professor's research, a specific platform may be a wiser venue for alternative scholarly communication, which will in turn drive the disciplinary professor to select a different altmetric.

Finally, faculty may not have considered the availability of their publications to the audiences that they are seeking to reach through alternative scholarly communications. This outreach presents the opportunity to discuss the problems of publications locked behind paywalls by traditional journals. Discussing open access or publication through alternative licenses in traditional journals (an open access license that makes the article available after a short embargo, for example) will help faculty to make their work available while they are promoting the work in these alternative venues.

Conclusion

Tenure track faculty can strategically build an online presence using available altmetric tools to their advantage. By considering factors of audience, type of information being disseminated and desired time to impact, librarians can assist faculty to think critically through the development of a plan that is most likely to serve the professors' alternative scholarly communication goals well. Simultaneously, librarians can point faculty member in ways that are most likely to preserve the scholarly record and perhaps educate faculty about open access practices.

References

1 Howard, J. Rise of 'altmetrics' revives questions about how to measure impact of research. *Chron High Educ [Internet]* (2013).
2 Priem, J., Taraborelli, D., Groth, P. & Neylon, C. Altmetrics: A manifesto. (2010).
3 Priem, J., Piwowar, H. A. & Hemminger, B. M. Altmetrics in the wild: Using social media to explore scholarly impact. *arXiv preprint arXiv:1203.4745* (2012).
4 Coppock, E. G. & Davis, L. Status of the adoption of social media in the scientific research community. *Information Services and Use* **33**, 203-217 (2013).
5 DiPietro, J. *Social media for engineers and scientists*. (New York, N.Y. 222 East 46th Street, New York, NY 10017 : Momentum Press, 2012).
6 Guerrero-Medina, G. *et al.* Supporting Diversity in Science through Social Networking. *PLoS Biol* **11**, e1001740 (2013).
7 Thilmany, J. PROFESSIONAL NETWORKING. *Mechanical Engineering* **135**, 41 (2013).
8 Gopsill, J. A., McAlpine, H. C. & Hicks, B. J. A social media framework to support engineering design communication. *Advanced Engineering Informatics* **27**, 580-597 (2013).
9 Neuroscience, N. Revolutionizing peer review. *Nat. Neurosci* **8**, 10.1038 (2005).
10 Vaughan, L. & Shaw, D. Web citation data for impact assessment: A comparison of four science disciplines. *Journal of the American Society for Information Science and Technology* **56**, 1075-1087 (2005).
11 Thelwall, M., Vaughan, L. & Björneborn, L. Webometrics. *ARIST* **39**, 81-135 (2005).
12 Sud, P. & Thelwall, M. Evaluating altmetrics. *Scientometrics* **98**, 1131-1143 (2014).
13 Popielarski, M. Assessing Altmetrics: Why Law Librarians (and Law Schools) Should Care About Altmetrics. *AALL Spectrum* **19**, 28 (2014).
14 Galligan, F. & Dyas-Correia, S. Altmetrics: Rethinking the way we measure. *Serials review* **39**, 56-61 (2013).
15 Ball, A. & Duke, M. *How to track the impact of research data with metrics*, <http://www.dcc.ac.uk/resources/how-guides/track-data-impact-metrics> (2015).
16 Thelwall, M., Haustein, S., Larivière, V. & Sugimoto, C. R. Do altmetrics work? Twitter and ten other social web services. *PloS one* **8**, e64841 (2013).
17 Zahedi, Z., Costas, R. & Wouters, P. How well developed are altmetrics? A cross-disciplinary analysis of the presence of 'alternative metrics' in scientific publications. *Scientometrics* **101**, 1491-1513 (2014).
18 Barnes, C. The Use of Altmetrics as a Tool for Measuring Research Impact. *Australian Academic & Research Libraries* **46**, 121-134, doi:10.1080/00048623.2014.1003174 (2015).
19 Shrivastava, R. & Mahajan, P. Relationship between citation counts and Mendeley readership metrics: A case of top 100 cited papers in Physics. *New Library World* **117**, 229-238 (2016).
20 Li, X., Thelwall, M. & Giustini, D. Validating online reference managers for scholarly impact measurement. *Scientometrics* **91**, 461-471 (2011).
21 Shrivastava, R. & Mahajan, P. Relationship amongst ResearchGate altmetric indicators and Scopus bibliometric indicators: The case of Panjab University Chandigarh (India). *New Library World* **116**, 564-577 (2015).
22 Bornmann, L. Alternative metrics in scientometrics: A meta-analysis of research into three altmetrics. *Scientometrics* **103**, 1123-1144 (2015).
23 Sotudeh, H., Mazarei, Z. & Mirzabeigi, M. CiteULike bookmarks are correlated to citations at journal and author levels in library and information science. *Scientometrics* **105**, 2237-2248 (2015).
24 Cabezas, Á., Jiménez, E. & Torres, D. Altmetrics: nuevos indicadores para la comunicación científica en la Web 2.0.

25 Barbaro, A., Gentili, D. & Rebuffi, C. Altmetrics as new indicators of scientific impact. *Journal of the European Association for Health Information and Libraries* **10**, 3-6 (2014).
26 Galloway, L. M., Pease, J. L. & Rauh, A. E. Introduction to altmetrics for science, technology, engineering, and mathematics (STEM) librarians. *Science & Technology Libraries* **32**, 335-345 (2013).
27 Adams, T. M. & Bullard, K. A. A Case Study of Librarian Outreach to Scientists: Collaborative Research and Scholarly Communication in Conservation Biology. *College & Undergraduate Libraries* **21**, 377-395 (2014).
28 Roemer, R. C. & Borchardt, R. . Altmetrics and the Role of Librarians. *Library Technology Reports* **51**, 31-37 (2015).
29 Lapinski, S., Piwowar, H. & Priem, J. Riding the crest of the altmetrics wave How librarians can help prepare faculty for the next generation of research impact metrics. *College & Research Libraries News* **74**, 292-300 (2013).
30 Parker-Gibson, N. We See You! Managing Profiles—about Them, about You. *Science & Technology Libraries* **34**, 122-133, doi:10.1080/0194262X.2015.1042622 (2015).
31 Bornmann, L. & Haunschild, R. Which people use which scientific papers? An evaluation of data from F1000 and Mendeley. *Journal of informetrics* **9**, 477-487 (2015).
32 Gardner, L. How to help researchers' discoveries go viral. *The Chronicle of Higher Education* **62**, 24 (2015).
33 Sapp Nelson, M. *Overview of altmetric tools available as of spring 2016.*, <http://docs.lib.purdue.edu/lib_fsdocs/131/> (2016).
34 McMurtrie, B. Fallout From Salaita Case Lingers on More Than One Campus. *Chronicle of Higher Education* **61**, A8-A9 (2015).
35 Perrin, A. *Social Media Usage: 2005-2015: 65% of Adults Now Use Social Networking Sites -- A Nearly Tenfold Jump in the Past Decade*, <http://www.pewinternet.org/files/2015/10/PI_2015-10-08_Social-Networking-Usage-2005-2015_FINAL.pdf> (2015).