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EDITORIAL

Communicating science for clean technology

Callie W. Babbitt[1]

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Since joining the editorial team of Clean Technologies and Environmental Policy, one of the unexpected things I have come to enjoy is receiving the email notification that I have a new manuscript submission ready for review. My instinctive response is curiosity and excitement about the new insights and discoveries that this submission may hold. This enthusiasm for new knowledge unites our community of authors, reviewers, and readers and perpetually motivates our research to create a more sustainable future.

However, the intellectual drive to continually create new knowledge, coupled with the practical pressures of research careers, can also detract from the motivation or time available for sharing discoveries once they are made. Unfortunately, writing is usually relegated to the final stages of research, and as a result, treated like a chore to be completed before moving on to new, exciting investigations. Writing with a singular objective to publish a journal article is certainly a necessary step to meet professional goals. Articles raise professional standing, deliver on research funding commitments, and pave the way for future research. However, writing is a critical part of the scientific process. Communication is fundamental to positioning discoveries within the broader body of knowledge, sharing scientific advances with key stakeholders, and ultimately translating research findings into meaningful "real world" solutions to environmental challenges.

When I click on the email link to view a new manuscript submission, my excitement about its potential is often dampened by the practical challenges of wading through dense writing and overly technical language to try to find a scientific gem hiding within. I am reminded of the quote, "what is written without effort is in general read without pleasure," attributed to English writer Samuel Johnson. In fact, the most common manuscript critiques from reviewers relate to writing and communication, from technical grammar mistakes and confusing organization to opaque methodology and difficulty explaining the novelty, significance, or context of research findings. When reviewers cannot understand the research because it is not communicated clearly, the manuscript faces a steep uphill battle for acceptance. While the ultimate test of a manuscript or published paper is its core scientific quality, rigor, and innovation, its long-term impact hinges on other authors and scientists choosing to read, cite, and share it in the future, underscoring the importance of timeless, clear communication.

Since I began in this editorial role, I've found myself sending authors decisions with the same types of feedback about writing and communication. I would elaborate on three of these common points here; perhaps they will be helpful in future submissions:

(1) *Academic writing is a form of storytelling:* Humans use stories every day to educate, entertain, and form connections. Journal articles can do the same for scientific research. The most engaging manuscripts capture readers' attention, draw them into the "plot" with vivid character and setting details, satisfy them with a successful resolution, and leave them anxiously awaiting the sequel. When reviewers criticize flow, organization, and clarity, it is typically a sign that the manuscript lacks a clear, story-driven narrative structure and instead follows a meandering path from opening to closing scenes.
(2) *Begin with the end in mind:* The cognitive constraints of the human brain limit the amount and complexity of information absorbed, even by scientists. Many articles cram in too many ancillary details, figures, or discussions, seemingly in the notion that more is better. Alternatively, successful manuscripts clearly set forth with a small set of key "take-home messages" in mind. Then the entire article builds a scaffold—from initial motivation to presentation and interpretation of results—that helps the reader follow the underlying thought process and arrive at the same key conclusions. It is helpful to remember that our success in writing is not meas-

✉ Callie W. Babbitt
cwbgis@rit.edu

[1] Rochester Institute of Technology, Rochester, NY, USA

ured by showing off how much we as authors know, but rather by how much our readers will have learned by the time they finish the article.

(3) *Know your audience:* In a non-scientific experiment, I observed an inverse correlation between the ease of finding reviewers willing to read a manuscript and the complexity, length, and overuse of jargons and acronyms in its title and abstract. While clean technology research is technical by nature, this journal has contributing researchers from diverse disciplines who apply a wide array of methods and case studies. Authors face a balancing act between the brevity required to convey scientific depth within page length constraints and the simplicity required to make the knowledge accessible to a broad readership. Simplifying language improves the ease with which a manuscript may be reviewed or read, and it also forces us, as authors, to distill our ideas to their core meaning, improving our own mastery of a subject.

The importance of science communication extends well beyond the academic publishing process. There is a growing recognition of the gap between scientific knowledge and public science understanding, informed decision-making, and research-to-practice translation. Traditional research dissemination strategies, such as scholarly journals or academic conferences, have limited reach into public dialog or realized benefit to broader stakeholders. However, the explosion of information and communication technology and resultant establishment of diverse social media platforms have expanded the tools available for researchers to reach a growing and global audience and more effectively integrate dissemination activities into research and professional development at all stages. New evidence suggests that sharing research through broad platforms (blogs, podcasts, social media sites, etc.) can actually foster new collaborations and research directions (Gruzd et al. 2012) and provide rapid feedback on research findings (Mandavilli 2011). A recent study has even shown a positive correlation between researchers' h-indices (a metric of citation impact) and the frequency of their work being mentioned on Twitter (Liang et al. 2014).

In the last two years, I have forayed into the world of Twitter (@CallieBabbitt) in hopes of sharing sustainability science with a broader audience and connecting with researchers, industrial partners, journalists, and thought leaders in this field. It is my goal to now use this platform to help publicize cutting-edge findings from our journal. As authors have papers accepted, I encourage you to post them to Twitter (I'm currently using the hashtags #CleanTech and #EnvPol but am open to suggestions!) or send me a brief description so I can help share your discoveries with a broader audience.

This journal has also made a recent change that will help communicate research in a new way. We now require manuscript submissions to include a Graphical Abstract that illustrates the most striking feature of the article in a pictorial form. Simplifying the entire manuscript to a core visual concept is often as challenging to an author as simplifying complex, technical writing. But the final product not only captures the science in an accessible manner, it also provides an eye-catching graphic useful for garnering public attention and sharing research across wider media platforms.

I am inspired by the idea that even as this editorial is being written, hundreds of authors are drafting future submissions to the journal. I can't wait to read their stories about the new discoveries that can advance technology and policy toward a sustainable future. I just hope that I—and the broader world's audience—will be able to understand them.

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