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Teaching Science Communication in the Writing Classroom

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Abstract: *In the wake of the discrediting of the "Sagan Effect," the present paper focuses on Science Communication as a pedagogical tool to train STEM students to share the stories of science with non-scientific communities and to heighten their audience awareness. The field of Science Communication is relatively new, but has experienced tremendous growth in recent years as it is important for science students not only to do science and write about it within their professions, but equally to learn to communicate their work and interests to wider publics. The findings of this paper include the importance of identifying and understanding target audiences, using appropriate language, and considering the cultural context of science information. The paper also concludes that Motivated Reasoning often played an essential part in Science Communication, and could be used in contexts such as the Climate Crisis.*

Key Words: *"Sagan Effect," Science Communication, SciComm, STEM, Motivated Reasoning, Audience Awareness, Pedagogy.*

1. INTRODUCTION:

In the wake of highly successful public-facing figures in science such as Richard Feynman and the discrediting of the infamous "Sagan Effect" which was biased against popularizers of science, the relatively new field of Science Communication – or SciComm -- has experienced tremendous growth in recent years, as scientists and researchers place increased importance on sharing their work not only with policymakers and members of the media, but with the larger non-scientific community. As discussed by Leavey in Routledge's new book *Theory and Best Practices in Science Communication Training*, ed. Todd P. Newman (2019), scientists and policy makers increasingly see value in community engagement and understanding about work in the sciences. Such 'citizen science' practices also help create feelings of self-efficacy about science and STEM in the public, thereby encouraging non-science individuals to develop the confidence that they can "do" science or at the very least have an identity as a person who sees or uses science in their everyday lives. This potentially allows individuals to feel included in 'scientific thinking' either as individuals or as part of a community where they are respected and valued and could even potentially influence policy.

This paper focuses on a new and experimental assignment in teaching Science Communication in the Writing Classroom. The assignment focused on audience awareness and sharing the stories of science with non-scientific communities and experiments with writing strategies that – for example – ask students to engage with diverse audiences and cultures so that the activities and benefits of scientific research and discoveries can be shared with wider audiences, and with communities through engagement and outreach.

2. LITERATURE REVIEW OF SCIENCE COMMUNICATION TRAINING:

Silva and Bultitude (2009) identified an interactive style as a key element to successful science communication training. A. B. Webb et al. (2012) found that repeated presentations enhanced neuroscience graduate students' ability to effectively communicate science content to the public. Science Communication work ranged from written, visual, and oral, or some combination thereof including presentations, press releases, news stories, blogs, and videos.

Miller et al.'s (2009) framework provided twelve modules for teaching skills-based engagement for broader audiences. These encompassed media writing, presenting research to policy makers, and science and culture. Building upon this in 2015 Mercer-Mapstone and Kuchel identified a list of twelve main science communication skills for university level students, including identifying/understanding target audiences, carefully chosen appropriate language, and taking into account cultural contexts of science information.

Besley et al. (2015) provided five goals as criteria for science communication training, such as making the message understandable to audiences as well as framing messages so they resonate with audience values. Longnecker (2016) points out that aligning communication activities with the recipients' sense of identity is critical for the communication to have an impact. Longnecker and Gondwe (2014) suggested that training content should mirror best practices by industry practitioners and balance theory with practical information. Dilger and McKeith stress the importance of "hands-on" learning over "traditional lecture-based" formats (11).

3. MATERIALS AND METHODS:

This experimental class began via videos and workshops at the excellent Alan Alda Center for Science Communication at Stonybrook University. The class then examined several websites and blogs that are great examples of science communication such as the one run by Discover Magazine, which has an abundance of articles written for wider audiences. Class discussions focused on how certain sites and posts are more impressive in content and communication style than others and that different blogs and sites target different groups, ages, and levels of education and knowledge, and to think about which ones they felt do a better job than others as they went through them. Sites such as informalscience.org offer a range of excellent options for students to explore; the table below lists useful places for students to explore:

Portal to the Public (PoP)	Helps informal learning organizations utilize and train scientists and engineers to have meaningful conversations with publics around local STEM issues. Has an implementation manual that provides guidance and resources for organizations looking to connect their communities to local science through meaningful, face-to-face conversation with scientists and other STEM professionals
SciStarter	Resource and community for researchers to find and recruit volunteers to contribute to their citizen science projects
Citizen Science Association	Brings together educators, scientists, data managers, and others to power citizen science and share the breadth of resources and best practices across different citizen science project types
The Role Models Matter Toolkit	Prepares STEM professionals to do outreach with girls and underrepresented youth. Includes hands-on STEM activities, reflection exercises, and tips for "dejargonizing" communication

An important additional resource in this experiment in teaching science communication in the writing classroom was Dr. Celestian, who conducts a research lab at the Natural History Museum of Los Angeles, and is a huge advocate of SciComm. Dr. Celestian takes his hardcore journal articles and converts them into articles for sites such as *Medium* that attract wider non-specialist audiences who are interested in learning about scientific topics. One of our early classroom activities was to go over two of Dr. Celestian's journal articles in addition to his reworked pieces for *Medium*, and to consider the strategies he had used in the process of rewriting.

In terms of the cycle of assignments, this was the second assignment of the semester. In the first research-based assignment, the students had picked a topic within their field or possible future profession in the sciences, and had used relevant journal articles as well as non-scholarly sources for their papers. We began the second assignment by discussing the various reasons why scientists might want to communicate science, ranging from the more idealistic such as wanting to educate the public about important public health issues (we have seen an uptick of this in the past year or two with the covid situation), pass their hard work and findings to the next generation and so contribute to the growth of human knowledge, to 'pay back' to society, to persuade politicians and policy makers etc.…to the more prosaic such as the desire to earn fame, money, or funding for future research. We then discussed the different places one sees popular science – science shows and pieces on TV and radio, science museums, science writing in magazines, newspapers, books etc., science festivals and other events, and science on the internet, including on YouTube and popular science sites. Topics for discussion included:

- What bits did these writers choose to emphasize, and why?
- What bits did they decide to leave out, and why?
- What were their choices with regards to the use of jargon and scientific terms?

- What were their choices regarding tone?
- How did the opening 'hook' or introductions to the pieces differ from those in journal articles?
- To what extent does Motivated Reasoning impact the ability to communicate with audiences?
- Can this Motivated Reasoning be used to spur social and environmental action for important causes such as Climate Change?

We also discussed how and why journal articles tend to use passive voice, while science communication pieces use a more active voice. Shulman et. al explain how it is vital to avoid the use of jargon, as the use of unfamiliar, specialized words tell audiences that they do not 'belong.' Even if a writer explains terms, Shulman goes on to explain, the damage has been done, as readers feel alienated and as if the piece is not for them: ""Exposure to jargon led people to report things like 'I'm not really good at science,' 'I'm not interested in learning about science,' and 'I'm not well qualified to participate in science discussions.'" Conversely, those who read versions without jargon felt "empowered" and "were more likely to say they understood what they read because they were a science kind of person, that they liked science and considered themselves knowledgeable."

The class also included two additional important 'communication' elements in the assignment. These were an audio-visual piece that would complement the written section (not just replicate it)…and a cartoon/meme of the student's own creation that would add humor and lightness, and help pull audiences in. This last was the piece many students were hesitant about, but was an important additional skill to develop as many science students do not have the chance to explore more creative, humor-filled, fun components to add to their work. Since it was not artistic talent that was on display per se, we emphasized that stick figures were fine, and that it was the idea and creativity of the cartoon or meme that was important, not drawing or painting skills. And sure enough, many students discovered a tiny bit of themselves that had lain dormant, and ended up enjoying these creative elements; several mentioned that they want to continue to develop these. Many of the students were interested in working on communicating science to their specific ethnic communities. We therefore discussed a range of community specific forms of communication, such as Telenovelas and Fotonovelas for Latino communities, such as the fun examples from a popular USC School of Pharmacy series created by Mal Baron. Some students in fact wrote and directed wonderful little 'telenovelas' on important social health related subjects such as getting tested for chlamydia, complete with sentimental violin music at emotional moments and dramatic moments with lovers tiffs and accusations of infidelity.

4. ANALYSIS:

- As the past year has brought home to each one of us, communicating science, especially in the context of a democracy, is quite literally a life-and-death matter – not to mention important for being able to continue to practice science by securing funding from public and private institutions.
- As evidenced by the wide range of scholarship in writing in STEM fields and the exciting new work being done in WAC classes on Science Writing for the Public, this is an exciting pedagogical field that fulfils the dual functions for WAC: the cognitive function, or "write to learn," and the rhetorical function, or "learn to write."
- In the past several years, therefore, the hot 'new' field of Science Communication (SciComm) has become central in the fight to save the earth and the many species that call it home, and it is vital for science students not only to do science and write about it within their professions, but equally to learn to communicate their work and interests to wider publics by identifying and understanding target audiences, using appropriate language, and considering the cultural context of science information.
- Writing about Science Communication fulfils an important mandate of several multidisciplinary classes, i.e. writing for different audiences such as peers and the general public. In order to write effectively, students identify an audience and decide what story they want them to learn.

5. FINDINGS

Findings include the importance of identifying and understanding target audiences, using appropriate language, and considering the cultural context of science information. As the table below illustrates, students carefully picked the medium they used to communicate science depending on their target audiences and chose appropriate language accordingly. Their pieces were targeted towards a broad range of audiences across language, culture, age, and educational-levels:

Medium chosen by student in 'audio-visual' section and/or written piece	**Target audience of student**	**No. of students who chose this medium/avenue to work on**

Fotonovelas, Telenovelas	First generation Latino community in Los Angeles (where we are located)	11
Short films modeled on popular TV shows	Indian, Asian, Middle-Eastern and other communities	15
Graphic novels, cartoon films, short movies	Middle-and-high-school audiences	10
Potential articles for sites such as Medium, Thought Catalog, Blavity, Truthout, The Outline, Huffington Post, and Teen Vogue.	Non-specialist college students/college-educated audiences	20

This experimental assignment in Teaching Science Communication in the Writing Classroom also concludes that Motivated Reasoning often played an essential part in Science Communication, and could be used in contexts such as the Climate Crisis.

6. RECOMMENDATIONS:

- Students should be given some days to first think about two questions: what complex topic in their field would they like to communicate, and what audience they want to communicate it to. Audiences could be, say, college-educated people who were non-specialists in the field but interested in science and in learning more, or the wider community. Furthermore, students could think about an even more specific audience such as musicians, sports enthusiasts, economists, congress, and the like.
- A considerable amount of time should be spent talking and freewriting about this in class: who do you want to communicate to, and WHY do you feel it is important to communicate your topic to that audience.
- Students should then find a scientific journal article on the topic they wanted to communicate, and then think about what medium(s) or mixes of mediums they thought would best accomplish their purposes for that particular audience. For example, a *Medium* piece would perhaps be a good place to communicate a more detailed piece to a college-educated audience, while a wider public would likely benefit from something along the lines of Reddit's popular "Explain Like I'm Five."

7. CONCLUSION AND FUTURE POSSIBILITIES:

Teaching Science Communication in the Writing Classroom works at multiple levels, including enriching diversity, inclusion, and community engagement by working on making the rarified world of science more accessible to all. With a focus on empathy and building common ground with an audience, such writing empowers its audiences to engage in meaningful ways with scientific knowledge and discovery. Science Communication is moreover a powerful tool for discovering information as well as for organizing and communicating it.

A related future assignment could focus on Medical Communication ("MedComm") for Health Sciences classes. The following SciComm articles produced by my students are valuable pieces of MedComm: https://spark.adobe.com/page/awYNd3p0nI3Ia/ for a great community-education piece on chlamydia-STD testing complete with a little student-written-and-directed telenovela to connect with the Latino community. Some students loved the idea of communicating science so much that they began their own SciComm journals after the class was over. As an example, the site https://yourdaily2cents.wixsite.com/website invites readers to "Offset your social 'footprint' and help us make science more accessible to women and other minorities!"

REFERENCES:

1. Besley, J. C., Dudo, A., & Storksdieck, M. (2015). Scientists' views about communi- cation training. Journal of Research in Science Teaching, 52, 199-220.
2. David YBB, Garty ES, Baram-Tsabari A. Can scientists fill the journalism void? Online public engagement with science stories authored by scientists. PLOS ONE. 2020 Jan 8; 15(1):1–15.
3. Dean, C (2009) Am I Making Myself Clear? A Scientist's Guide to Talking to the Public. Cambridge, MA: Harvard University Press.
4. Dilger, A. C., & McKeith, F. K. (2015). Training graduate students to communicate science to broad audiences. Animal Frontiers, 5(3), 60-63.

5. Karpenter, CJ, Boster, FJ (2013) Modeling the effects of processing effort and ability in response to persuasive message arguments. Communication Quarterly 61: 413–430.
6. Longnecker, N. (2016). An integrated model of science communication: More than providing evidence. Journal of Science Communication, 15(5), 1-13.
7. Longnecker, N., & Gondwe, M. (2014). Graduate degree programmes in science communication: Educating and training science communicators to work with communities. In L. T. Wee Hin & R. Subramaniam (Eds.), Communicating science to the public (pp. 141-160). Dordrecht, Netherlands: Springer.
8. Mercer-Mapstone, L., & Kuchel, L. (2015). Teaching scientists to communicate: Evidence-based assessment for undergraduate science communication. International Journal of Science Education, 37, 1613-1638.
9. Miller, S. (2009). So where's the theory? On the relationship between science communication practice and research. In D. Cheng, M. Claessens, N. R. J. Gascoigne, J. Metcalfe, B. Schiele & S. Shi (Eds.), Communicating science in social contexts: New models, new practices (pp. 275-287). Dordrecht, Netherlands: Springer.30 Science Communication 40(1)
10. Newman TP. Theory and Best Practices in Science Communication Training. Routledge; 2019.
11. Rodgers, Shelly & Wang, Ze & Maras, Melissa & Burgoyne, Suzanne & Balakrishnan, Bimal & Stemmle, Jon & Schultz, Jack. (2018). Decoding Science: Development and Evaluation of a Science Communication Training Program Using a Triangulated Framework. Science Communication. 40. 3-32. 10.1177/1075547017747285.
12. Shulman HC, Dixon GN, Bullock OM, Colon-Amill D. The effects of jargon on processing fluency, self-perceptions, and scientific engagement. J Lang Soc Psych. Epub 2020 Jan 29.
13. Silva, J., & Bultitude, K. (2009). Best practices in communication training for public engagement with science, technology, engineering, and mathematics. Journal of Science Communication, 8(2), 1-13.
14. Webb, A. B., Fetsch, C. R., Israel, E., Roman, C. M., Encarnacion, C. H., Zacks, J. M., . . . Herzog, E. D. (2012). Training scientists in a science center improves science communication to the public. Advances in Physiological Education, 36, 72-76.
15. Yuan S, Kanthawala S, Ott-Fulmore T. "Listening" to Science: Science Podcasters' View and Practice in Strategic Science Communication. Science Communication. December 2022.