

Fostering the Art of Scientific Communication in the Center

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Our research asks how communication centers can assist advanced graduate students in the sciences to foster the art of developing scientific presentations for expert, non-expert, and generalist audiences. In a sustained collaboration supported by a national grant, the communication center at a mid-sized public comprehensive regional university in the Southeastern United States has facilitated a series of workshops for select graduate fellows in the sciences in recent years. In each of these workshops, we focus heavily on audience adaptation, thus creating a vibrant conversation between the disciplines of communication studies and the sciences. This research project collects data from workshops held in 2017 and 2018. Via a co-constructed narrative, we examine the notion of audience from the perspective of the research participants as well as administrators and graduate students who facilitated the workshops.

Introduction

The university communication center is located centrally on campus in the main library and has a mandate to serve the entirety of the campus, including students, staff, and faculty from all disciplines. The center is staffed by undergraduate peer-consultants from a variety of majors, as well as graduate students in the discipline of communication studies, and it is overseen by a faculty director. Approximately 45% of our 1,750-2,000 appointments annually, consist of clients from the basic public speaking course, while the remainder of our appointments, events, and activities serve a variety of other disciplines and/or are done in collaboration with various offices and groups on campus.

Several years ago, an opportunity arose for the communication center to collaborate in training graduate research fellows in the sciences on their

communication and presentation skills for expert- and non-expert audiences. A series of workshops were developed in consultation with the communication center director and grant administrator, who has a background and advanced degree in communication studies. The workshops include practice and instruction on brief “elevator pitch” research statements appropriate for professional settings; practice, instruction, and one-to-one assistance in developing 15-minute formal research presentations appropriate for academic settings; and 3MT (3-minute thesis) competition preparation appropriate for public settings.

Most National Science Foundation (NSF) programs that involve graduate students require training in scientific communication, specifically regarding communicating research and scientific advances to the public. Two NSF programs

sparked the collaboration with the communication center. The first was the GK-12 program in which graduate students in STEM and high school teachers develop lessons and activities for a high school classroom. Graduate students spent 10 hours per week in a high school science classroom to enhance the communication of their research to a non-scientific audience. Most recently, the NSF National Research Trainee (NRT) program focuses on developing the skills, knowledge, and competencies needed for graduate students pursuing a range of STEM careers. One area of this program is workforce development, which includes several communication initiatives such as elevator pitches, research updates and interviewing. The communication center has been a successful partner with these NSF programs for over 10 years.

Literature Review

Operating outside of the formal classroom and curriculum, communication centers provide low-stakes environments for students to develop and practice communication skills and competencies, usually in one-to-one or small group, peer-to-peer settings (Yook & Atkins-Sayre, 2012). While the communication center collaborates closely with instructors and students enrolled in the classes that fulfill the university's speaking-intensive curricular requirements, its interdisciplinary nature presents opportunities to support the entire campus in more creative and visionary ways. For example, the center often hosts workshops for students tasked with multimodal presentations in disciplines ranging from history to geology to nursing, collaborates with the university's new student and retention offices, and, along with the writing center, provides faculty development in rhetorical pedagogies across the disciplines. Especially for advanced graduate students who understand

themselves as hard scientists, a focus on audience adaptation is key in learning how to mobilize disciplinary discourse in various contexts. In offering a space for interdisciplinary conversation, one of the goals of the communication center is to break apart barriers and assumptions that we have about the sciences, and vice versa.

Despite acknowledgement that communicating science should be an interdisciplinary effort that includes rhetorical approaches toward audience awareness and knowledge construction, traditional deficit models of education continue to predominate conversations about scientific communication pedagogy (Besley & Tanner, 2011; Lee & VanDyke, 2015). Deficit models of instruction assume a top-down approach of knowledge dissemination whereby one expert communicates impersonally to an audience who can then act based upon gained knowledge (Varner, 2014). However, a recent emphasis on Broader Impacts by the NSF "forces scientists to think more carefully about the ways in which their work impacts society" (Tretkoff, 2007, p. 1). That is, the merit of scientific research is no longer judged solely on intellectual advancement but also through its applicability for audiences who often do not work in the sciences. Thus, the practice of communicating science can greatly benefit from training in the art of communication.

Increasingly, interdisciplinary collaborations with communication studies are aiding scientific fields in recognizing and practicing rhetorical approaches to communicating science (Cicerone, 2006; Dudo & Besley, 2016; Nisbet, 2008). Public understanding of scientific knowledge and research is crucial for citizens to act responsibly, and scientists "need to accept the principle that the scientific community functions within society, not the other way around" (Wooden,

2006, p. 1058). Communicating science to nonscientists can be a vexing task, though. What should the public know? Pedagogies aimed at involving the public are increasingly more aware that scientific knowledge is potentially more impactful when it is addressed to the specific needs of its audience (Pytlik Zillig & Tomkins, 2011). As such, the study of rhetoric and its focus on structure of presentation lends itself appropriately to a more formalized practice like science (Fahnestock, 2013). For example, Gigante (2014) found that the rhetorical nature of communicating science “struck my students as surprising, as most of them had been very comfortable with the concept of objectivity being a ‘real thing’ in science” (Gigante, 2014, p. 81). Therefore, tailoring science communication to the concerns of one’s audience can engage those who may not have felt previously engaged with the subject.

A focus on audience is crucial to ongoing developments in science communication pedagogies. According to a 2017 report from The National Academies of Sciences, Engineering, and Medicine, communicating science to general audiences is best practiced by developing presentations that already match common learning behaviors (2017). Specifically, the notions of *framing* and *uncertainty* play key roles in gathering audience attention and building comprehension of complex, scientific subjects (National Academies of Sciences, Engineering, and Medicine, 2017). Framing is simply presenting information in a way that audiences can easily understand and interpret through common organizational patterns. When framing science through a problem/solution or cause/effect format, for example, audiences are instinctually aware that an emphasis on understanding the issue is key not just for scientists but society as well (National Academies of Sciences, Engineering, and Medicine, 2017). Framing

informs audiences of what an expert found as important through a simple process and, therefore, rhetorical choices of communicating science “will likely resonate more with those less informed and less interested in an issue” (Rothwell, 2014, p. 256). Additionally, scientific topics that pose complex workings create uncertainty, or the inability to understand and predict how an event will occur. Communicators who use a narrative approach, or tell a story about an issue, then, relate to audiences’ understanding of history, personal impact of a subject, challenges to dealing with complexity, and the relatability of confronting the unknown (Rothwell, 2014). Simply put, telling a story about a scientific subject breaks down information into common human experiences of learning how to handle uncertainty (Lucas, 2012). Thus, science communicators can relate complex subjects to general audiences by framing information into common organizational patterns or stories which help answer uncertainty.

To serve and support the entirety of the college campus, communication centers must adapt to accommodate diverse audiences from various disciplinary backgrounds. Each discipline is essentially its own discourse community, so it is our task, as a communication center, to adapt our educational materials and understand their unique projects and understandings through the process of audience adaptation. Yook and Atkins-Sayre (2012) explain that audience adaptation “requires knowledge of audience demographics, audience emotion, audience knowledge, audience interest, audience comfort, and audience expectations” (p. 33). More importantly, the communication center offers a space where interdisciplinary scholars can learn to adapt to their various discourse communities, including scientific, non-scientific, and generalist audiences.

A primary focus of audience adaptation is meeting audiences where they are (Cuny, Wilde, & Stevens, 2012). This is enacted by listening empathetically to students' goals, implementing tactics that involve observing students' strengths and weaknesses, learning speakers' concerns and investments in their research projects, and adapting to address the needs of each individual client. Communication center consultants are tasked with transferring skills they have honed in numerous academic environments to work with diverse audiences from various disciplinary backgrounds. A key element in successfully implementing these strategies is to establish and maintain trust with speakers. Communication center consultants must prioritize respect for each student's agency and context to achieve trust (Beard, 2018).

Communication centers focus on audience adaptation to satisfy the interdisciplinary nature of our work. By constructing partnerships with a variety of programs around campus, communication centers may progress toward the overall goal of strengthening students' communication competencies as well as extending the impact and reach of the communication center (Connors & Brammer, 2018). Collaboration between academic and student support programs and communication centers may lead to enhanced university connections for students, higher retention rates, increased student success, and higher achievement in collaborative projects and workshops (Stone, 2008).

Communication centers are thus poised to become increasingly important sites for interdisciplinary collaborations, especially with the sciences. Because of their low-stakes, peer-to-peer focus, communication centers offer a unique space and social environment where scientists can develop their rhetorical sensibilities, explicating the discursive practices with

which they are previously unfamiliar for the purposes of future recontextualizing based on encounters with various audiences and exigencies (Nowacek, 2011). In the meantime, communication center practitioners have much to learn from scientists.

Methods

Co-constructed narratives help participants reflect upon their work and life experiences by identifying what they have learned from challenges (Preez, 2013). For the current study, public speaking offers challenges not just to the general public but especially those in scientific fields. Consideration for how one's research will be understood by a nonscientific audience is still a relatively new practice for the scientific community (Gigante, 2014; Wooden, 2006). There are challenges for those in the discipline of communication too. Understanding complex, scientific processes could make messaging and presentation structure difficult because much time needs to be devoted to learning before a consultant can provide critical input. Reflecting upon a partnership between the sciences and a communication center can help make sense of how the two form a relationship despite these challenges. Because of their collaborative character, co-constructed narratives exhibit the shared meanings that their authors have for the events in which all parties contributed (Gallardo & Mellon-Gallardo, 2007). By allowing both groups to look back on their experiences, then, emergent themes of common understanding can provide insight for future interdisciplinary workshops and partnerships.

Of the different forms that co-constructed narratives can take, the most popular is the cyclical, continuing dialogue that connects closely-related individuals through a topic that was unexamined in their

relationship. By looking back at the same events and writing separate accounts of how each remembered them, similarities emerge that help authors grasp a shared connection. This ultimately reframes the relationship to focus on the good that came out of a complex situation (Davis & Salkin, 2005). For those who are not closely related, co-constructed narratives can also help illuminate the learning process that interactants experience when trying something new. By engaging with those they are unfamiliar with, participants gain new educational and social skills much like characters who are challenged in a narrative (Emo & Wells, 201). Thus, we sought to identify how all participants grew and converged in meaning of the task at hand (communicating science) after reflecting upon our experiences in the workshops and instruction sessions.

University IRB approval was granted before responses could be collected from 11 graduate student participants in the sciences whose personally-identifying information remains confidential. Participants were asked to recall the workshops and elaborate on the following questions in a Qualtrics survey: 1) How has your understanding of the art of scientific communication changed? 2) How has your understanding of presenting to diverse audiences changed? Before coding the data, the authors (3 graduate students in communication studies; 1 grant and department administrator; 1 faculty member and communication center director) also wrote responses to the same questions from their unique perspectives. The authors then met to identify common themes across the responses.

In answering question #1 above, we noted that the participants understand communication as a process; and in answering question #2 that they developed generosity toward their audiences. In the co-constructed narrative that follows, we weave

the participant responses into our reflections on the collaboration, observing another overarching theme that emerged in the research: a renewed sense of confidence among all involved.

Narrative

Scientific communication

By focusing on a process orientation, our communication center shares the guiding adage that “the goal isn’t better speeches, but better speakers” (Turner & Scheckels, 2015, p. xiv). In other words, while we do offer a certain amount of instruction on aspects of delivery such as eye contact, verbal fillers, hand gestures, etc., more of our work is centered around content, substance, and rhetorical adaptability. In coding and reviewing the responses to Survey Question #1 (“How has your understanding of the art of scientific communication changed?”), the researchers found that a process orientation indeed emerged as a common theme throughout the responses.

For example, one participant wrote, “I didn’t realize there was so much work that can go into the art of scientific communication,” indicating a previously-held belief that the “work” occurred in the scientific process, not the communicative transaction. Similarly, another participant wrote that “you cannot dump results onto an audience,” again suggesting a change in understanding of communication as a well-considered process rather than isolated event. Another wrote, simply, “I’ve become a more conscious presenter,” and another, “I have learned that communicat[ing] science is more difficult than I first thought.”

On communicating science as a process, several respondents detailed the role of technical content while considering one’s audience. One participant wrote

“Initially, the impression that I had regarding scientific communication was that one needs to present and discuss as much scientific and technical content as possible to an audience to seem smart.... However, I realized that.... No matter if the work one does isn't flashy or pathbreaking the way it is presented to an audience is what matters.”

Again, participants noted a shift in attitude toward understanding communication as a process and set of competencies transferable across various audiences and contexts. Similarly, in thinking about scientific and non-expert audiences, another participant wrote, “there is no need to go into all the scientific details when talking with other scientists.” In all, in response to the first question, a process orientation emerged in which scientists realized the importance of considering and adapting to one's audience.

Audience

While there are some common symbols displayed from all responses—“tailoring” one's work to a lay audience, avoiding “jargon,” simple “explaining” complex processes, and understanding how a general “audience” would react to a specialized study—research question two generated some unique distinctions in terms of the role that communication plays with *generosity* towards an audience. What we mean by generosity is that respondents emphasized a need to place audience first and subject matter second when presenting scientific research to diverse audiences. Responses unique to research question two were “repetition,” “high-to-low level of understanding,” “scientific literacy,” “tune out,” “inclusion/exclusion,” and “fit” to an audience. These symbols indicate an awareness that the audience does not possess the knowledge and attention needed for a complex subject. For example, one student

remarked that the workshops helped them realize the importance of just one word in communicating to those without their same understanding. “I've really learned how to tune my speeches so everyone can understand...it's been challenging to figure out which words can be swapped and what needs to stay.” Other responses laid out similar ideas of meeting an audience where they are, such as one presenter who “struck a balance between communicating to the more and less knowledgeable members of the audience. What may seem obvious to us may be totally missed by someone not familiar with our field.” These responses displayed a greater understanding of one's overall purpose in reaching out to connect with an audience not familiar with science:

“I was under the impression that a scientific or technical presentation is usually directed towards an audience that is well-versed with your field...participating and eventually winning the 3MT competition made me realize that there's more to a technical talk than just several plots and data...now whenever I give a presentation about my research, I make sure I tell a story that captivates the audience and I start at a much higher level and then delve deep into a few aspects which I believe my audience will comprehend and enjoy listening to.”

Therefore, the theme of generosity illustrated presenter's awareness of communicating science in a way that helps audiences learn and keep interest in the topic.

Communication center graduate students

As graduate peer consultants, we wanted the workshops to emphasize the practice of communication as a knowledge-based process in which audience, language,

and organization structure how presenters address listeners. For example, our workshops addressed audience through activities that asked presenters to communicate their research to hypothetical groups, such as middle-school students, undeclared college students, and faculty members within their specific field of study. Through trial-and-error, students became more efficient at addressing particular audience knowledge while becoming comfortable with communicating in front of others. In terms of language, presenters are asked to critically analyze the most often used jargon terms within their research. After identifying these words and phrases, they were asked to explain them to workshop presenters who have no scientific background. The two groups then worked together to identify language that mirrors the action and process that the jargon indicates. This includes common metaphors, analogies, clichés, and cultural references that students can then repeat throughout their presentation as a common ground of understanding.

Lastly, organization sought to give presenters common frames in which to communicate knowledge to those with no understanding of their topic. Scientific communicators are typically research students who are trying to improve or solve an issue. Giving audiences the background of that issue, its real-world application, where it is currently seen, and why it matters helps create relevance for even those unfamiliar or uninterested in a presenter's topic. Workshop activities on organization focus on structuring one's topic through a problem/solution, cause/effect, historical/narrative, or a combination of these formats that helps presenters see the importance of creating knowledge through the communication process or organization.

By keeping the idea of audience central to discussions about how to organize

and prepare research presentations, too, the science students and communication graduate student peer consultants fostered mutual respect and understanding of one another. Each helped the other create a space to explore varied methods of presenting potentially unfamiliar information in interesting and appropriate ways. We (communication studies graduate students) learned from our scientist colleagues about the specific requirements and norms of their academic and professional discourse. Our role, then, was to ask questions and clarify those requirements so that our peers could meet them with confidence and clarity. As experts in a highly technical field, the scientists helped us to understand the unique challenges and opportunities of science communication. This improved our work with students across academic disciplines and exemplifies the possibilities of a strong organizational relationship with support from leadership in improving communication both within and outside of our home discipline.

Science Education Grant

Administrator. From the perspective of the NSF grant administrator, the communication center assists in developing of graduate students fostering the art of developing scientific presentation to diverse audiences. With over 15 years' experience in NSF grant administration as well as an advanced degree in communication studies, I observe students pursuing advanced degrees in STEM who have never been exposed to the basics in presentation development and delivery. Most of the students entering STEM graduate programs completed an undergraduate degree that did not require a communication elective, and they have never presented a formal presentation much less a technical research presentation. Throughout a STEM graduate student's career, I observe that many students struggle

with confidence in their presentation skills. They are well-versed in the technical terms, jargon and language of their discipline but adapting those terms and presenting them appears to be a challenge. Usually when STEM graduate students practice their technical research presentations it is for an audience of their research group peers and faculty research advisor, who possess the same technical background and knowledge of their topic. When we challenge students to begin the process of presenting their research to a non-scientific audience, many do not have a general audience to practice presenting their research presentations.

The communication center offers the STEM graduate students the ability to practice with other graduate students who specialize in communication as well as being their peer as a fellow graduate student pursuing a Ph.D. The communication studies peer consultants provide the STEM graduate students a non-scientific audience to banter ideas with regarding the significance of their research. Through this relationship, I have observed the confidence of the STEM graduate students increase as they collaborate with these communication peer consultants. The center has been an effective tool in building the STEM student's confidence in presenting their research through the peer mentors, numerous presentation development workshops and providing a general non-scientific audience for feedback.

In addition, the communication center provides the students with a judgement free, collaborative space for the students to practice their research presentations. As noted above, most of the STEM graduate students practice their presentations in front of their research group peers and faculty research advisor. Presenting in front of research peers, especially those graduate students that are more senior, as well as their faculty research

advisor, can cause many students to develop anxiety surrounding the detailed technicalities involved in presenting their research. Many of these students are apprehensive in presenting the technical portion of their presentation for fear of judgement of their peers and research advisor. Because many of these STEM graduate students have never had a communication course as an undergraduate, they have not been educated on basic presentation development. The students spend most of their preparation time focused on the communication of the technical research background, methodology, and results to make sure they communicate it correctly versus focusing on general presentation basics. The communication center, with its staff of peer consultants, provide the STEM graduate students a judgement free space for them to practice and receive support and feedback. When these students work with peer consultants, they are more willing to ask questions as well as seek feedback on their delivery. During the workshops, the STEM graduate students tend to shift their focus from the technical portion of their presentation to more on the delivery of the information. The center is a safe space for STEM graduate students to work on presentation outlining, transitions, defining jargon, non-verbal communication and perfecting the delivery of their presentation.

Faculty Director. From the perspective of a faculty director and administrator, my answer to the wholesale question about how communication centers can assist advanced graduate students in the sciences to foster the art of developing scientific presentations to diverse audiences has a number of facets. First, as seen throughout the responses from participants as well as the reflections by graduate student consultants, the importance

of the center's environment as a low-stakes, judgment-free space that exists outside of the realm of formal evaluation is paramount. The science students tend to be under a great deal of pressure to "sound smart," as one participant put it, often hiding behind jargon and technical detail instead of communicating carefully with the audience at hand. They assume a performance orientation in public speaking, where aspects of delivery take precedence over content, which, for already high-achieving students, raises the level of anxiety considerably. In creating an open, supportive, welcoming environment, the communication center allows scientists to let down their guard and more fully explain the substance of their research. In turn, the graduate peer consultants, embodying the role of "expert outsiders" (Nowacek & Hughes, 2015), learned to make honest, well-placed questions about the scientific research when the technical content did not seem to logically follow.

A second and related observation, then, is that both groups of students gained much confidence throughout the collaboration. In connecting with peers outside of the discipline, the scientists began to articulate the implications of their research without a sense of pandering to a non-scientific audience—an intellectual generosity emerged, in other words. In turn, the communication center graduate student peer consultants were encouraged to authentically engage with the scientific research, rather than throwing up their hands and saying, no, not for me, or this is out of my wheelhouse. In fact, for me, the most important takeaway from the collaboration is exactly thus: all parties, in deeply considering audience as key to the rhetorical situation, were invited to see themselves as scholarly experts. This kind of professional training is truly invaluable, especially for our doctoral students.

Conclusion

A reflection on the sustained relationship between advanced graduate students in the STEM fields and consultants from a communication center provided fruitful results in assessing institutional objectives of interdisciplinary collaborations. Through a co-constructed narrative, both groups converged to emphasize the importance that an audience holds in communicating complex ideas. With the help of NSF grants and multiple workshop instructional sessions, both groups learned the expertise of the other and collaborated to create a common discourse of understanding built upon process, generosity, and gaining confidence in the art of communication. We hope this is not a brief glimpse but a sustained look at how the two fields interact to advance understanding and applicability of the skills gained throughout the partnership. Specifically, future research on how the scientific presentations are received by general audiences can further assess the effectiveness of the interdisciplinary collaboration.

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