Journal of Museum Education Reader Guide
Volume 11, 2016

"The Research Communication Continuum: Linking Public Engagement Skills to the Advancement of Cross-disciplinary Research"

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Journal of Museum Education, Volume 41, Number 4, December 2016, pp. 315-328.

MUSEUM EDUCATION ROUNDTABLE

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Journal of Museum Education Reader Guide

"The Research Communication Continuum: Linking Public Engagement Skills to the Advancement of Cross-disciplinary Research"

by Carol Lynn Alpert

In Carol Lynn Alpert's article "The Research Communication Continuum: Linking Public Engagement Skills to the Advancement of Cross-disciplinary Research," Alpert challenges the one-directional model of museum-university partnerships and makes a case for mutually beneficial and strategic collaborations.

In a one-directional model, for example, scholarship comes from the academy to the museum where it's then presented through storyline, objects and experience for public consumption. In her article, Alpert describes a project at the Museum of Science, Boston where benefits flow back to the academy from museum practice. Specifically, museum educators—whose "domain expertise" lies in communication techniques and interpreting scholarly knowledge to broader audiences—brought skills and training to research scientists that they could apply to cross-disciplinary communication and collaboration.

The aim of this Reader Guide is to provide open-ended questions for personal reflection, to guide thinking towards action, and how one might approach a multi-directional partnership between museums and universities. We had the opportunity to work with the author to think about what might be some of the key "ingredients," tools and mindset needed for a mutually beneficial and strategic collaboration.

Reflecting...

1. Beyond being experts in a particular content area, what kinds of skills or "domain expertise" do museum educators have that can benefit others inside and outside the museum (for example, "people skills," "effective communication," or specific skills for engagement with specific audiences)?
2. What kinds of unique skills do you possess that might benefit work outside of the museum? How did you come to acquire those skills?
3. Reflect on your own experiences where you've been included in specialized communities with specific references, terminology, language that you might take for granted. What might it be like to be a newcomer to this community? Try to remember what it was like to be fresh to the museum field, its content and jargon.

(continued)

Applying...

4. If you work in an institution, what are the current strengths of your institution? For example, content expertise, methods or skills for translating content to a variety of audiences, physical space dedicated to programming, existing relationships with organizations.
5. Are you involved in existing partnerships where you work? Are they one-directional or mutually beneficial? What are the benefits of the partnership to you? To your collaborators? Can you think of ways to make the collaboration more mutually beneficial?
6. What are the barriers to making partnerships more mutual? For example, are additional resources needed? If so, what kinds of resources, specifically? Carol Lynn suggests the use of Review Committees to work through resources, staff and finances that are needed for new partnerships. Would this be a good way to start developing a culture of partnership at your institution?

Theorizing...

7. How might we evaluate a mutually beneficial partnership? Think through the goals of your institution, your partnership institution, or even the funding agency supporting your partnership.
8. How can you assess your impact? How might the partnership improve what you do? Is the partnership sustainable?
9. Is there potential for mutually beneficial museum-university partnerships to enhance research in museum education? What might be the potential of museum-university partnerships in the future landscape of museum education itself?

Further Reading

Nina Simon, *The Art of Relevance,* 2016.

Museum of Science, Boston, "A Guide for Building Partnerships Between Science Museums and University-Based Research Centers."

Institutions with strong museum/university partnerships

- Science World partnership with the University of British Columbia, A Living Lab
- Phillips Collection & University of Maryland
- University of California Los Angeles & Los Angeles County Museum of Art

Organizations featured in articles in "Museums & Universities: Partnerships with Lasting Impact" *Journal of Museum Education*, 41.4, 2016:

- Program in Museums and Society/Johns Hopkins University
- Collaborations between Dr. Elyssa Ford at North West Missouri State University and the Nodaway County Historical Society

(continued)

- Center for Cultural Technology, a partnership between New Mexico Highlands University and the New Mexico Department of Cultural Affairs
- The New Bedford Whaling Museum High School Apprenticeship Program
- The North Carolina Museum of Natural Sciences with campuses of the University of North Carolina System
- The Center of Science and Industry in partnership with Ohio State University
- Collaborations between the Children's Museum of New Hampshire and the University of New Hampshire's Education Department
- Partnerships between Loyola University Chicago's Teaching Learning and Leading with Schools and Communities Teacher preparation program and the Adler Planetarium, Chicago Children's Museum, Chicago History Museum, the Chicago Academy of Sciences, Peggy Notebaert Nature Museum, Shedd Aquarium and The Field Museum.

JOURNAL OF MUSEUM EDUCATION, 2016
VOL. 41, NO. 4, 315–328
http://dx.doi.org/10.1080/10598650.2016.1232528

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Taylor & Francis Group

The Research Communication Continuum: Linking Public Engagement Skills to the Advancement of Cross-disciplinary Research

Carol Lynn Alpert

ABSTRACT
This paper theorizes and provides evidence of a "Research Communication Continuum" in which acquisition of skills conducive to communication with broader audiences contributes to greater efficacy in cross-disciplinary discourse and collaboration among scientists and engineers engaged in research; and, vice versa, acquisition of skills conducive to cross-disciplinary discourse and collaboration among scientists and engineers contributes to greater efficacy communicating with broader audiences. At first glance, this may seem a trivial observation; however, as explored here, it could have profound implications for how we conceive and carry out future museum–university partnerships, and it suggests new approaches for improving the productivity of cross-disciplinary research while also enhancing graduate education and facilitating public engagement through a broad range of integrated science communication professional development activities.

ARTICLE HISTORY
Received 2 June 2016
Accepted 1 September 2016

KEYWORDS
Research communication continuum; science communication; cross-disciplinary research; museum–university partnerships; graduate education; public engagement; broader impacts

Museum–university partnerships 2.0

We tend to think of university and museum partnerships as unidirectional – scholarship flows from the academy, informs museum curatorial and education staff, and we, in turn, select and shape storylines around tangible objects and experiences, translating and transmitting knowledge to the broader community.

We seldom pause to ask, however, what benefits *besides* greater public awareness could flow back to the academy as a result of their participation in this partnership? Are there opportunities that have gone unrecognized and undeveloped simply because we have not looked for them? Could museum curators and educators use our domain expertise to contribute to the advancement of research within the academy? And, if so, what steps could we take to identify and cultivate these potential benefits to our academy partners?

Here, I briefly describe a set of experiments in which a museum group identified an important aspect of academy practice to which we felt we could bring our domain expertise, and then developed and tested a variety of methods for applying it. We set our sights on bettering cross-disciplinary technical discourse *within* the academy and at research meetings and conferences – specifically, oral presentations of research aided by slides, graphics, and posters. Using constructivist pedagogy, we guided university researchers

in adapting, for their professional use, communication principles we regularly employ as translators and interpreters of scholarly knowledge to public audiences.

We theorize a "Research Communication Continuum" in which the acquisition of skills helpful for communicating with broader audiences also produces greater effectiveness in cross-disciplinary communication and collaboration within the academy; and, vice versa, the acquisition of skills conducive to cross-disciplinary professional discourse and collaboration within the academy also contributes to greater success communicating with broader audiences. At first glance, this may seem a trivial observation; however, it could have profound implications for how we conceive and carry out future museum – university partnerships. Let us begin with the genesis of the concept.

Outreach: science museums as interpreters of current research

The Museum of Science in Boston was among the first science museums to establish a physical arena dedicated to the interpretation of ongoing scientific and engineering research for broader audiences.[1] In 2002, our Current Science & Technology Center earned a National Institute of Standards and Technology "Best Practices in Interpreting Current Science & Technology to Public Audiences Award," and a gold American Alliance of Museums MUSE Award. The effort proved successful due in no small part to the willingness of federal science funding agencies to support informal science education and outreach activities associated with their larger investments in university-based research. For example, National Science Foundation's (NSF) Broader Impacts Criterion can unite university researchers and museum educators in efforts to attract young people to science and engineering and increase public awareness of current research. In our model,[2] these outreach collaborations are funded from a portion of the university research award, and they bring scientists and engineers face to face with public audiences, transmitting not just knowledge, but also personal connection, cultural familiarity, and insight into the human passion, motivation, and collaborative nature of scientific research. When we joined with others to launch the NSF Nanoscale Informal Science Education Network in 2005, we began efforts to disseminate this partnership model, encouraging other science museums and research centers to develop funded collaborations. We produced a handy resource, "A Guide for Building Partnerships Between Science Museums and University-Based Research Centers."[3] Currently, organizations such as the Center for the Advancement of Informal Science Education, the National Alliance for Broader Impacts, Portal to the Public (PoP) and the new National Informal STEM Education Network have launched other efforts promoting museum–university partnerships.

Turning it around: inward to the academy

We did not launch our broader-impacts partnership model in 2001 intending to change the culture of science communication *within* the academy, and nobody expected us to do that; we concentrated instead on the external vector, often termed "education outreach." We translated scientific complexity, theory, and evidence into stories of human discovery and innovation, and we designed hands-on experiences to engage the interest and imagination of field trip, family, and adult audiences. We coached university professors on methods of transforming their academy-style lectures to family-friendly

"meet the researcher" gallery encounters, and we inducted dozens of graduate students and postdoctoral associates into the spirit and practice of informal science learning through our "Sharing Science Workshop & Practicum" sessions.[4] We also hosted intensive "Science Communication Internships," cultivating graduate student ingenuity in developing hands-on explorations, comic science animations, and 15-minute gallery talks (Figure 1).

We thought of these activities as expanding the pool of effective science communicators, perhaps inspiring a new generation of researchers with a lifelong dedication to public outreach, reverberating on into the future. However, we received some comments about these activities on the participant feedback surveys that surprised us:

> It increased my confidence and made me more relaxed. I had to go for an interview that evening and the workshop experience gave me an idea of communicating better with professionals and nonprofessionals in daily life.[5]

> It gave me ideas about communicating with different audiences, which is very useful, even for writing scientific papers.[6]

> If I ever want to make a presentation for the public it will look much different from what I'd make for a technical audience. It wouldn't have a week ago. I suspect my technical presentations won't ever be the same either.[7]

> This internship did a lot to refocus me as a presenter of science. Although I used to think that I knew how to see my slides from the audience's perspective, I didn't. Now I have a much better idea and it's given me a new lens through which to critically address my presentations.[8]

Figure 1. MIT, Harvard, and Howard University graduate students explore communicating science with broader audiences at the museum during the Science Communication Internship program and the Sharing Science Workshop & Practicum. Credit: J. Antill (left); C. L. Alpert (right).

Our trainees in education outreach were reporting positive impacts on their professional communication activities, including research talks, journal articles, and job interviews. Professional training in communication skills is mostly lacking in STEM higher education,[9] so we surmised that the museum training was giving students practice speaking about their research in simpler, more conversational terms, paying attention to how their audience might be equipped to receive and process new information. Curators and educators, particularly in science and children's museums, are finely attuned to audience attention spans and to the varying degrees of visitor familiarity with the topics at hand. We know we need to engage audience interest, rouse curiosity, and provide contextual relevance to common experience. We structure our material into stories, make eye contact, move dynamically, and draw analogies to everyday phenomena. We design graphics for clarity and visibility – to illuminate our story, not to distract. In short, we produce communication experiences with *the needs of our audience always in mind.* Many of us incorporate front-end and formative research into our design process, getting familiar with the mindscapes our audiences bring to the occasion, and often prototyping, testing, and iterating until we know we have a product that engages *and* produces insight.

But this is not typical practice within the academy. Attending the research exchange meetings and conferences frequented by our university partners, we noted that – like museum visitors – members of the academy are not immune to being *dis*engaged by poorly organized talks loaded with specialized jargon and expert blind spots. Across a typical meeting room, we saw minds, hands, and hearts engaged in text chatter and email. Few speakers, it seemed, were willing to make the effort to connect to the diversity of experience in the room. Most assumed audience knowledge of the significance or motivation underlying their investigations. Others delivered their remarks in monotone, without eye contact. Some even turned their back, reading off their slides. Slides were often so packed with data they came across as symbologies of complex ideas decipherable only within highly specialized communities. The frugality with which digital real estate was allotted for cramped figures and graphs seemed to reflect the myopia of late night laptop sessions with only the author to please, perhaps with publication in mind, but certainly not a live audience in a large room. As one of our MIT graduate student trainees put it,

> Although there is generally some conscious attempt to make the science more approachable in interdisciplinary settings, the efforts fall short of really imparting understanding to people in other fields. In particular, there is a weakness in how data and results are explained and contextualized for those unfamiliar with the field.[10]

The tragedy is that many students assume the fault is their own:

> I always thought that I didn't understand a talk because I didn't know enough, but [now] I realize some talks are [so] poorly organized and prepared that it's not the audience's fault that the talk is hard to understand.[11]

How to explain the evolution of this type of meeting culture? Was it always like this? Could the "cognitive style of PowerPoint" be to blame, as Edward Tufte argued?[12] Could it be that in our accelerating multiplexed world, the face-to-face research exchange meeting is simply a hollow vestige of a tradition established long before online journals and today's feverish competition for position and funding? Is the research presentation dead?

I do not think so. I think we can bring back genuine sharing of knowledge and ideas at cross-disciplinary meetings, by drawing attention to and encouraging good communication practices tailored to these live settings. Content, story structure, delivery, visual aids, audience connection: these are the essential elements. At a meeting, they exist in a four-dimensional zone, progressing relentlessly through time. A missed connection, an overlooked step in the story's flow, and all further insights may be compromised. We cannot turn back the page. The same may be experienced by visitors moving through a packed museum gallery. But the meeting audience, confined to their seats, tempted by their digital communication devices, may drift off mentally, and this only emphasizes the need to make the performance as compelling as possible while striving for real-time clarity. At issue is how to connect to the particular audience there in the room. The problem, and a hint at the solution, was stated succinctly by a 2010 participant in our Science Communication Internship:

> Mostly I just talk science to the people in my lab, and since we all have the same background, communication is pretty easy. But it can be quite difficult to explain to others, and I think the only way to get better at it is through practice.[13]

Practice, plus a bit of coaching and cultivation of audience awareness.

Coaching members of the academy in professional science communication

We made the decision to seek a greater role in the education and training of students and postdocs in the academy. Would our offer be accepted? This was a delicate issue, because we were seen as outreach folks, experts in the world of "science edutainment," but not in academy affairs. Here is how it played out, in a series of increasingly embedded configurations.

The science communication workshop for undergraduate research program students

The low-hanging fruit was to begin with *under*graduate students participating in 10–12-week summer NSF-funded Research Experience for Undergraduates (REU) programs, which are often associated with university-based NSF-funded research centers. The stakes are not as high with these summer programs designed to provide a taste of graduate work in science and engineering to a diverse cohort of students. We offer the students a pair of intensive afternoon workshops at the museum, or on campus, lunch included, bracketing the summer program. The students are self-motivated, since they all want to ace their final research presentations.

Key to the pedagogy of these sessions is hands-on practice, the tried and true constructivist learning model. We do not give students a lecture on how to communicate their research; instead, we get them working with their own material in small groups, exploring new ways to communicate their research to one another, guided by mentors we have taught to foster constructive feedback and peer support within the group. We seek to empower each student to draw on the resources of this learning community while developing his or her own voice and style (Figure 2). The first session, at the beginning of the summer, introduces students to the notion of context and motivation and sends them back

Figure 2. Undergraduate researchers with the Center for Integrated Quantum Materials warm up in small groups during Session One of the Science Communication Workshop at Harvard, sharing brief introductions to the motivation, significance, and approach of their individual lab projects. Credit: C. L. Alpert.

to their labs to make inquiries of their advisors and mentors. The second session, near the end of the summer, has them working in small groups, delivering drafts of their research project presentations, adjusting organization, slides, delivery, and overall choreography. By the final week of the program, they can proudly deliver a professional-style presentation on the results of their first immersion in graduate-level research (Figure 3). And, when they return home, they can also explain to friends and family, in intelligible language, what they did on their summer vacation – a skill that could mean the difference between being ostracized as a geek or winning peer and community backing for their graduate school plans.

Figure 3. Following Session Two of the Science Communication Workshop, undergraduate research students at the University of Massachusetts – Lowell (left) and at Harvard (right) deliver dynamic final presentations with clarity and self-assurance. They have also learned to size their images for audiences in large rooms. Credit: M. Litwhiler (left); K. Hollar (right).

The REU SCW proved so successful with our local university partners[14] that we developed a Planning & Implementation Guide[15] and a unique facilitator-training model.[16] The workshops are now being implemented at between 8 and 12 university research centers each year, and we are collecting evaluation data from most of them. For example, in the most recent completed year, 2015, 139 students on 8 campuses participated in the program, and the average response rate was 79% for the four surveys administered over the summer. Ninety percent of students credited the REU SCW with improving their science communication skills (18% very much; 34% much; 38% moderately improved).[17] Whenever the REU SCW is launched at a new location, faculty report improvement in the quality of their students' final research presentations. There are now 12 experienced REU SCW workshop providers across the U.S., and 933 students have participated in the program since 2006. This is a professional science communication-training product that has transmogrified almost completely from the museum world to the university world.[18]

The research communication laboratory

We had been accepted first as providers of graduate-level education outreach training, and now as providers of undergraduate research communication training. Could we now be accepted as providers of graduate-level professional research communication training?

As a graduate student at MIT in 2010, Raoul Correa participated in our one-week intensive Science Communication Internship, a feature of our partnership with the NSF Nanoscale Science and Engineering Center headquartered at Harvard. Under our tutelage, he developed a very successful public presentation on quantum dot research (see Figure 1).[19] A year or two later, he was a part of MIT's Center for Excitonics and much admired for his success at communicating the center's research to its funders. He told the center director he had honed these skills during his internship at the Museum of Science, and shortly thereafter, we began offering a graduate-level Research Communication Lab at MIT. The RCL deliberately bridges formal and informal communication as a professional development strategy. Assignments range from making a Pixar-inspired PowerPoint presentation about one's research to writing a *Nature* abstract. But the central focus is on developing short-format research presentations for cross-disciplinary research meetings. The center's students work in different specialized areas – chemical engineering, physics, materials science, computational theory- and it can take weeks before they feel confident enough to admit they have not understood key parts of a classmate's presentation. But once the pretense is over, once everyone realizes that the majority of their peers have had some trouble understanding particular parts of their presentations, they begin to provide each other with valuable feedback – certainly better feedback than we can provide. We send them out with a critical eye and ear to the various seminars they normally attend, and they come back dumbfounded at how much time has been wasted and opportunities lost by speakers who cannot bridge to an audience of some of the most brilliant minds in graduate STEM education. The RCL class has been running for five years now and is well regarded by students and faculty. The center director supports it out of his own department funds. One of the more ironic end-of-year survey responses we received was this one:

> Beware the curse of RCL! RCL will utterly ruin seminars because 80% of researchers (even big name profs!) do not live up to the standard RCL sets for establishing motivation, and many don't come remotely close. You will constantly see examples of poor audience awareness, assuming that a general scientific audience will already know why some things are inherently interesting, and (the biggest one) failing to contextualize their results with each other and with their motivation. All of these things will drive you crazy, and you can never un-learn what you will learn![20]

More typical (and more expressive of the goal of the course):

> During this year I attended two conferences and gave two 15-minute talks. From my own perspective the talks went a lot better than the talks I had given before. Some people came to talk to me afterwards for potential collaborations and my colleagues always got excited after they saw my talk. An improved talk definitely helped by drawing people's attention to the work I have done.[21]

The research communication challenge

We had been accepted in the academy as providers of undergraduate and graduate professional research communication training. Could we now join forces with faculty and embed the effort into center-wide activities?

The idea was to launch a research presentation contest for grad students and postdocs delivering five-minute talks at the Annual Meeting of a major cross-disciplinary research center, the NSF Center for Integrated Quantum Materials, headquartered at Harvard. We would offer cash prizes, design a judging rubric, recruit faculty judges, and provide presentation workshops and individual coaching sessions at each of the three participating universities. Would the center director and manager agree to such a significant intervention at a meeting to which all faculty and industry affiliates were invited? Would any faculty members agree to sit attentively throughout the long day, scoring speakers? Could we come up with a judging rubric and a scoring method efficient enough to use in real time? Yes, yes, yes, and yes.

The acceptance of poor presentation skills is so engrained in scientific meeting culture that when I first asked the center director about recruiting faculty judges, he replied, "don't bother – they'll never agree to do it – it's mind-numbing listening to all those student talks." *That's exactly why we need this*, I thought. What is the purpose of an annual meeting except to share ideas, inform, and foster progress on all fronts? I began to vet the idea with center faculty in one-on-one phone calls. Without exception, they recognized the pervasiveness of the problem. One-by-one they endorsed the trial effort, providing valuable advice on the design of a streamlined rubric. Many even volunteered to judge.

We developed a confidential web-based polling app that was a cinch to use on smart phones, tablets, and laptops. This allowed an "audience choice" poll to run concurrently alongside the judging panel's scoring. Everyone in the room could participate, nurturing their own innate awareness of the qualities that contribute to making presentations effective. Since October 2014, we have implemented the research communication challenge (RCC) twice at CIQM annual meetings at Harvard and MIT (Figure 4) and twice at Center for Excitonics annual meetings at MIT. Center directors, managers, and faculty credit the RCC with improving the quality of all the talks and the quality of the meetings themselves. Attendees stayed in the room and paid attention. Industry attendees

Figure 4. Winners of the 2015 RCC at the CIQM annual meeting pose with their awards along with center director, Bob Westervelt (at right); co-PI Gary Harris (at left); and co-PI Carol Lynn Alpert (center). Credit: Mark Beals/MIT.

participated in judging and provided valuable feedback. Here is a sprinkling of comments made in response to an open-ended query at the end of the CIQM scoring survey:[22]

- The talks were much better this year!
- Very engaging and enjoyable.
- There was a very noticeable difference in the quality of the talks this year … the coaching made a big impact.
- The talks were of a uniformly high caliber.
- I know the students greatly benefited from this experience.
- I really like this format for rapid topics and presentation challenge for young students and postdocs. It is entertaining and educational.

The independent Center evaluator conducted focus groups after the 2015 CIQM annual meeting, and reported these comments:[23]

> Faculty feel the [presentation training and Research Communication Challenge] are among the top CIQM activities that are beneficial for students and postdocs … . Knowing how to give a five-minute talk is a valuable skill, and the opportunity to judge the presentations is a great experience.
>
> Graduate students appreciated the opportunity to practice their presentation skills, and report that the Museum of Science training is one of the only opportunities they have to do this …

Following the 2016 Center for Excitonics annual meeting at MIT the director and manager wrote:

> [We] agree that this was by far the best All-Hands meeting we've had to date … the competition increased the quality of the talks and kept us on schedule.[24]

We concluded that the RCC increased the effectiveness of these meetings as arenas for cross-disciplinary communication and collaboration, as well as increasing the

educational value of the meeting for students and postdocs. It is impossible to rigorously quantify these benefits; though we are able to show that more training correlates with better outcomes for individual speakers.[25] I reported these results at the 2015 NSF Nanoscale Science and Engineering Grantees meeting,[26] and at the 2016 CIQM site visit. NSF program officers and other center directors took notice, and began recommending the program to other cross-disciplinary research centers. It seems that everyone is aware of the problem of boring meetings and inaccessible research talks, but few expected that an intervention like the RCC could have a significant impact.

Presentation Rx clinic at AAAS annual meetings

We had been accepted as partners with faculty in raising communication standards for students and postdocs at university research center meetings. Would faculty themselves accept guidance in developing and delivering presentations?

The membership of the American Association for the Advancement of Science includes scientists, social scientists, and engineers across the entire spectrum of research. Symposia held at the Annual Meetings offer mixed communication experiences. Some speakers are able to bridge the chasm to interested parties outside their specialty; many cannot. As in every large conference, year after year, speakers follow the same routine of plunking so many tiny bits of information on slides so that no one beyond the first few rows can see what is on them. They turn their back to the audience and read their bullet points. They drop jargon right and left and cling to their inscrutable acronyms. Why is this considered communication?

In 2012, I proposed an experiment to AAAS: let us set up a speaker's clinic at the next annual meeting – we can call it Presentation Rx – and offer presenters free hour-long appointments with some of us who provide guidance in science communication. We tried it out at the 2013 and 2014 meetings as volunteers, with some support from AAAS. Each consultant worked with their "client" on organization, clarity, slides, delivery – whatever was the low-hanging fruit that could make an impact in the hours or days they had before their talk. When asked, in the feedback form, "What did you find most helpful about your Presentation Rx Clinic Session?" we received replies like these:[27]

- It was helpful to see the presentation through the eyes of a knowledgeable person not familiar with the topic.
- Frank feedback about how complex or confusing some of my slides were.
- Talking about the issues, what to emphasize, insights into who the audience would be and what they were thinking.
- A fresh perspective outside my field helped me to clarify my presentation and improve the flow.

Participants were unanimous in recommending that Presentation Rx be offered at future AAAS meetings. In 2014, AAAS meeting organizers decided to assume responsibility for Clinic management, embedding the concept into the normal fabric of future meetings, with continuing help from us and other volunteer consultants.

Conclusion

Museum education, interpretation, and curatorial skills do have a place in the larger universe. We chose to extend ours into the realm of cross-disciplinary science communication. I'll be interested to see where others are taking theirs.

Discussion: the research communication continuum

I understand that some people will read this paper and ask, what is different about the science communication pedagogy emerging out of this museum-university partnership experience? After all, training for scientists in communicating to public audiences is getting a lot of attention these days, much of it spurred on by an unsettling undercurrent of anti-science sentiment and urgent issues like climate change denial. The hope is that if scientists can learn how to be personable and to communicate to lay audiences, they will be able to explain the facts clearly, countering the flow of misinformation. The hope is that scientists can counter the flow of misinformation; they can learn how to be more personable and to present validated truths in ways lay-people can absorb and understand. However, the new "science of science communication" tells us that where certain policy issues are concerned, no amount of carefully-communicated, scientifically-validated information is likely to alter an individual's stance, if that information conflicts with deeply held political, economic, or religious worldviews.[28] Many science communication coaches thus focus on teaching scientists how to "frame the issue" and "get their message across," borrowing terms often used in marketing and in politics.[29] These are vitally important efforts, but they do not underlie our particular pedagogy.

Museums are among America's most trusted public institutions.[30] Except when purposefully organizing forums for citizen deliberation on public policy related to science and technology, they tend to focus more on sharing knowledge (and the quest for knowledge) with public audiences, and less on messaging. In addition, my group's particular history working with academy partners in the interpretation of areas of basic research still far from application led us to apply our communication knowledge to improving – not their messaging abilities (although they still need to justify the use of funding and resources for their research) – but the efficacy of their intramural cross-disciplinary discourse and knowledge-sharing. In other words, our new science communication professional development models are focused on helping scientists talk intelligibly to *one another*. The goal is to help catalyze further innovation at those fertile interstices between highly specialized fields. The meaning of the Research Communication Continuum is not that if you can help shape public opinion you can collaborate better with your colleagues in other specialized areas, but that if you can communicate the why and how, the context and potential impact of your research effectively to public audiences, you can also do a better job communicating it to other researchers and to potential collaborators. Yes, let us help researchers communicate successfully with public audiences, but let us also help them communicate with each other.

Notes

1. Alpert, "Bridging the Gap."
2. Alpert, "Broadening and Deepening the Impact."

3. Alpert, *A Guide to Building Partnerships Between Science Museums and University-Based Research Centers* (The earliest version of this Guide appeared online in 2008).
4. Alpert, *Sharing Science Workshop & Practicum Planning and Implementation Guide*.
5. UMass Donahue Institute Research & Evaluation Group, "Sharing Science Workshops, Fall 2009 Survey Results."
6. Ibid.
7. Miller, "Science Communication Internship Survey Data 2010."
8. Ibid.
9. A scan of the literature reveals considerable hand-wringing over this distressing situation. Kuehne "Practical Science Communication Strategies for Graduate Students" includes an excellent summary of the barriers to providing science communication training in academia.
10. Alpert, "Year-End MIT RCL Class Survey Data 2016."
11. Ibid.
12. Tufte, *The Cognitive Style of Powerpoint*
13. Miller, "Science Communication Internship Survey Data 2010."
14. UMass Donahue Institute Research & Evaluation Group, "Center for High-Rate Nanomanufacturing Research Experience for Undergraduates."
15. Alpert, *REU Science Communication Workshop Planning & Implementation Guide*.
16. Alpert, "Beyond 'Train-the-Trainer:'"
17. Thate, "REU SCW Network-Wide Survey Data, 2015."
18. Alpert, "Can a National Network of Undergraduate Research Program Directors Validate a Set of Professional Skills-Building Science Communication Workshops?"
19. Correa, "An Introduction to Quantum Dots."
20. Alpert, "Year-End MIT RCL Class Survey Data 2016."
21. Ibid.
22. Thate, "Research Communication Challenge Participant Survey 10/15/15."
23. Lenaburg, "CIQM 2015 Focus Group Summary."
24. Email communication with the author, January 2016.
25. Lenaburg, "Report on the 2014 Annual Meeting Micro Presentation Challenge."
26. Alpert, "Enhancing Research: A New Approach to Graduate Training in Science Communication."
27. Thate, "AAAS Presentation Rx Clinic Feedback Survey Data Set, 2014."
28. Scheufele, "Science Communication as Political Communication."
29. Nisbet, "What's Next for Science Communication?"
30. Reach Advisors/ASTC. *Preserve Past, Teach Present, Inspire Future*.

Acknowledgements

The author wishes to thank the following individuals who have helped make this work possible: Marc Baldo, Carol Barry, Larry Bell, Lubi Lenaburg, Karine Thate, and Bob Westervelt; also, the many program participants who have shared their experiences and insights with us.

Disclosure statement

No potential conflict of interest was reported by the author.

Funding

Primary support for this work was provided by the U.S. National Science Foundation (NSF), through the Center for Integrated Quantum Materials [DMR 123139] and the Nanoscale Informal Science Education Network [DRL 0940143]. This paper also reports on work supported by NSF through [PHY 0117795], [PHY 0646094], [EEC 0832785], [EEC 0832785], [EEC 1460988], [ESI 0532536]; and on work contracted by the Research Laboratory of Electronics at MIT in association with the Center for Excitonics, an Energy Frontier Research Center funded by the U.S. Department

of Energy Office of Science. Logistical support for Presentation Rx was provided by the American Association for the Advancement of Science.

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