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TWENTY YEARS OF SCIENCE COMMUNICATION: LOOKING BACK, LOOKING FORWARD

Advancing inclusion through culturally relevant science communication: a perspective from Puerto Rico

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Abstract

The past 20 years of science communication have seen important progress towards inclusion, equity, and justice. In this commentary, I review some of those changes and discuss how culturally relevant science communication activities are part of a broad movement seeking to change the culture, research, and practice of science communication. I draw on my experiences as a practitioner working with the nonprofit organization Ciencia Puerto Rico (CienciaPR) to offer lessons for the whole field to continue to address past and present exclusions and injustices and avoid future ones.

Keywords

Community action; Professionalism, professional development and training in science communication; Public engagement with science and technology

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I invite you to think about what makes *you* feel connected to science. What makes science meaningful *to you*? Maybe it's curiosity, an experience from early life, something about the food that your family ate, or a place you visited. Most likely, you found a connection between something from your culture — the collection of people's languages, customs, beliefs, previous experiences and knowledge, and identities — and your interest in science. That's because culture influences our interests in and approaches to science [Davies & Horst, 2016].

I see this in my own experience. I was born and raised on a tropical island in Puerto Rico, on a farm, in a working-class rural community, where raising animals and growing our food was a way of life. Community elders knew what herb could calm an itch or relieve a stomachache. That's why I feel connected to science by the beach, cows, lizards, and the rural community where I was raised. Although it seems obvious now, it wasn't until adulthood that I realized the deep connection between my love and aptitude for science and my cultural background.

People value, understand, and engage with science through their own cultural lenses [Medin & Bang, 2014; Davies, Halpern, Horst, A. Kirby & Bruce Lewenstein, 2019]. Science learning is enhanced when concepts are made relevant to an individual's context and culture [Barton & Tan, 2010; Brown, 2017; Byrd, 2016; González-Espada et al., 2015; Guerrero-Medina et al., 2013; Tan & Barton, 2018]. Yet, too often, science is presented as a predominantly white, Western, male, and privileged endeavor; it's decontextualized and disconnected from the culture and realities of historically marginalized communities, further excluding them from science [Barton, Menezes, Mayas, Ambrogio & Ballard, 2018; Canfield et al., 2020; Neeley et al., 2020; Finlay et al., 2021].

Culturally relevant science communication offers ways to counter these challenges and promote equity and inclusion. Drawing from literature in science teaching and science communication [Manzini, 2003; Medin & Bang, 2014; Gay, 2018; Mensah, 2021; University of Oregon School of Journalism & Communication, 2022; Baxter, 2022], culturally relevant (or culturally responsive) science communication can be defined as one that leverages the cultural knowledge, prior experiences, and identities of an audience to make science more pertinent and valuable for them. Culturally relevant science communication connects science to people's everyday lives, who they are, and what they care about, and by doing so can help make science more meaningful to different audiences, counter harmful stereotypes, and promote a sense of agency and belonging, especially among historically excluded populations [Guerrero-Medina et al., 2013; González-Espada et al., 2015; Davies et al., 2019; Baxter, 2022].

In this commentary, I draw on my experiences over the past 16 years working with the nonprofit organization Ciencia Puerto Rico (CienciaPR). I explore the value and impact of culturally relevant science communication. Finally, I share key lessons learned, reflect on how culturally relevant efforts can contribute to making science communication more inclusive, and make some observations about the challenges and opportunities ahead.

Moving towards more inclusive science communication

During the past two decades, science communication scholars and practitioners have recognized the need to address historical, current, and structural shortcomings to make its research and practice more inclusive and equitable.

There is increased awareness of inclusive science communication approaches including asset-based learning [Burks & Menezes, 2018], community engagement [Birmingham et al., 2017; McCreedy, Maryboy, Litts, Streit & Jafri, 2018], and culturally relevant science communication [Guerrero-Medina et al., 2013; Baxter, 2022]. Diversity, equity, inclusion, and justice in science communication are increasingly front and center, instead of a niche or special interest, at national and international conferences and scientific organizational meetings (e.g., the American Association for the Advancement of Science (AAAS) Communicating Science Symposium, the National Academies Science Communication Colloquium).

Most importantly, there has been action. We now have resources and initiatives to improve research, practice, and scholarship focused on inclusive science communication (e.g., Center for Advancement of Informal Science Education (CAISE) Broadening Participation Toolkit; Inclusive Science Communication in

Theory and Practice, Frontiers in Communication Research Topic). Notably, in 2018, the University of Rhode Island founded the Inclusive Science Communication (ISC; https://inclusivescicomm.org/) Symposium (full disclosure: I have been part of its organizing and advisory committees). The ISC Symposium has helped improve the understanding of challenges, needs and opportunities in the field and is providing tools to accelerate the adoption of ISC approaches [DiCenzo et al., 2021] and thus foster much needed systemic and structural change. Encouragingly, there are many more inclusive practitioners, researchers, and efforts than when I entered science communication and the value of this collective work is being recognized.

CienciaPR's efforts in culturally relevant science communication to promote inclusion fit in the broader context of these endeavors. They exemplify ways that culturally relevant science communication can advance science communication and foster structural changes at the community, organizational, and national levels. Started in 2006, CienciaPR leads the way in promoting the civic participation of scientists in Puerto Rico, and integrating science and Puerto Rican culture and identities through science communication, formal and informal science education, and public engagement [Guerrero-Medina et al., 2013]. Below, I describe a couple of case studies from our work training scientists and partnering with marginalized communities in Puerto Rico to build capacity for culturally relevant science communication and promote equity and inclusion.

Training scientists in culturally relevant science communication

Scientists play a key role in communicating and engaging the public with science [Guerrero-Medina et al., 2013]. To be proficient and effective science communicators, scientists need skills and practice [Besley, Dudo, Yuan & Lawrence, 2018; Clarkson, Rohde, Houghton & Chen, 2018; Dudo et al., 2018; Bennett, Dudo, Yuan & Besley, 2019; Besley, Newman, Dudo & Tiffany, 2021]. For the past 10 years, CienciaPR has trained scientists and other science, technology, engineering, and math (STEM) students and professionals in culturally relevant science communication tactics (e.g., understanding and connecting with diverse audiences, messaging and framing, and working on various platforms) and facilitated their participation in our various science communication and education initiatives.

Our trainings include workshops, panels, and seminars at academic institutions and professional conferences, and webinars. For example, we have organized inclusive science communication sessions at meetings (e.g., annual conference of the Society for the Advancement of Chicanos/Hispanics and Native Americans or SACNAS), on topics including science communication research, advocacy, and storytelling, among others. These typically include short presentations by experts, hands-on exercises, and Q&As.

Our professional development programs like the Yale Ciencia Academy (YCA; http://www.cienciapr.org/yca) also feature science communication trainings as a core component. YCA participants (doctoral students in biomedical and health sciences) receive 3–8 hours' trainings where they learn fundamental principles and strategies for effective and inclusive science communication. They complete self-reflection and group exercises to, for example, identify how their experiences inform their communication goals and consider the sociocultural backgrounds of

their audiences. YCA participants can complete an activity of their choice (e.g., podcasts, school visits, public lectures, symposia, and newspaper articles, among others) during the year-long program.

CienciaPR's training has increased the science communication capacity of hundreds of scientists and fostered their engagement with different audiences, especially Puerto Ricans. From 2016 to 2020, 185 YCA participants completed 160 engagement activities that reached 53,858 people. Alumni of YCA and other CienciaPR programs put their skills into action following Hurricane Maria (2017) by supporting storm relief and recovery activities, such as community mindfulness and mental health workshops and trainings for healthcare workers to prevent mosquito-borne diseases. YCA alumni started and are leading their own culturally relevant science communication efforts (e.g., Ciencia en Tus Manos, Vistazo a la Ciencia). CienciaPR-trained scientists have published several dozens of op-eds and conducted numerous media interviews as part of CienciaPR's COVID-19 communication efforts since the beginning of the pandemic. These media publications include El Nuevo Día, Puerto Rico's newspaper of note, Es Mental, NPR, CBS, New York Times, and Associated Press.

Partnering with marginalized communities to address under-information and misinformation with culturally relevant science communication

For decades there has been a chronic lack of timely, accurate, accessible, and culturally relevant science and public health information in Spanish in the U.S. and Puerto Rico [Landis et al., 2020; Márquez & Porras, 2020], which contributes to the vulnerabilities and health disparities faced by these populations [Oh, Trinh, Vang & Becerra, 2020; Preidt, 2021]. The COVID-19 pandemic intensified the need and urgency to address health under-information and misinformation among Spanish-speaking audiences.

To meet these challenges, in September 2020, CienciaPR created "Aquí Nos Cuidamos" (ANC; https://www.aquinoscuidamos.org/), a project to promote COVID-19 prevention and mental health among marginalized communities in Puerto Rico through Spanish-language, culturally relevant multimedia education and community engagement. ANC featured a toolkit with four public service campaigns with more than 200 freely available audios, videos (in Spanish and sign language), images, and guides. ANC's community engagement program included a community ambassador program that supported 10 Puerto Rican leaders in their COVID-19 efforts; workshops; community forums and WhatsApp chats; and partnerships with more than 17 non-profits, public and private entities.

Aquí Nos Cuidamos' multimedia content used different strategies to connect evidence-based COVID-19 protective behaviors to Puerto Rican culture. For example, our video for the campaign "Distancia física, no social" (Physical, not social distancing) [Ciencia Puerto Rico, 2021] appealed to the values of community care and solidarity, it used illustrations of everyday life (e.g., a house with decorative window bars that are ubiquitous in Puerto Rico) and included music featuring traditional Puerto Rican instruments to encourage risk mitigation behaviors against the coronavirus.

We hosted more than a dozen listening sessions and conversations to understand the needs, questions, and realities of marginalized communities, and Q&As with COVID-19 experts, including YCA alumni. These community interactions

continually informed project activities, how we created and adapted our content for different audiences. For example, our engagement with Deaf community members led us to prioritize the inclusion of sign language interpreters in all audiovisual materials and videoconferences (instead of just captions).

We conservatively estimate that ANC has reached more than 200,000 people in Puerto Rico alone. Our toolkit has been used by community leaders at dozens of testing and vaccination clinics, by non-profit organizations and community-based organizations at health fairs and on social media, and by municipal and national government entities, like the Puerto Rico House of Representatives. Culturally relevant approaches were key to the success of this project and establishing trust with all our partners. We are building on these relationships through Laboratorio de Ciencia Comunitaria (Community Science Lab or CienciaCoLab), a new program to provide community leaders in Puerto Rico with training, networking, mentoring, and financial support to create community-led science projects that address local challenges and priorities.

Lessons learned, challenges, and opportunities

Although CienciaPR's work centers around Puerto Rico, our approaches and what we have learned are broadly applicable to other regions of the world. I suspect that the challenges we have faced are also shared by others in science communication. I explore some of these challenges below and provide a look ahead.

4.1 Centering community

From the start, CienciaPR was conceived of as a community for anyone with an interest in science and Puerto Rico [Guerrero-Medina et al., 2013]. We take the approach that a community is a set of relationships where there is a sense of trust, belonging, and common interests and purpose [Chavis & Lee, 2015]. We have more than 15,000 members around the world, and at that scale, community building is time consuming and resource-intensive. However, it is critical for meaningful, equitable, and inclusive (and thus, culturally relevant) communication [Baxter, 2022]. Beyond numbers, CienciaPR's success is due to our focus on cultivating long-term partnerships with and between different people and groups (e.g., scientists, grassroots leaders, nonprofits) and providing CienciaPR members with initiatives, training, and programs to put their assets (e.g., knowledge, networks), interests (in science and Puerto Rico, science communication, etc.), and purpose (to improve lives and society in Puerto Rico) into action.

4.2 Research-practice challenges

Many innovations from the practice of inclusive science communication have not yet reached the peer reviewed literature [Canfield et al., 2020]. There has been little research assessing the impact and effectiveness of different inclusive science communication interventions. Canfield et al. [2020] outlines key opportunities, including case studies to clarify how program objectives and settings influence outcomes, identify strategies to address systemic failures, and understand how cultural processes and epistemological orientations inform effective science communication, and among others. One area that I am particularly interested in is

the intersection between culturally relevant science communication and misinformation. For example, Spanish-speakers in the United States are targeted by dis- and misinformation campaigns about elections and public health, among other topics [Longoria, D., Urbani & Smith, 2021; Gold & Contreras, 2022]. Can culturally relevant strategies improve people's management of false or misleading information? Which are most effective? Community leaders have told us that Aquí Nos Cuidamos' culturally relevant content helped them understand the ever-changing COVID-19 context, encourage mask use and vaccination, and address rumors and misconceptions in their communities. However, systematically understanding how culturally relevant and other inclusive science communication strategies can effectively address misinformation is critical to advance equity.

4.3 Funding and organizational capacity

Community building, inclusion, and equity require infrastructure, skills, and resources — and thus, funding. In the United States, funders have made strides supporting projects and creating mechanisms for inclusive science communication (e.g., Science Communication Identities Project funded by the National Science Foundation, Rita Allen's Civic Science Fellows Program). However, ongoing support for these types of efforts remains relatively scarce. And beyond money, funders need to make changes in grantmaking; the emphasis is often on deliverables with a relatively short timeframe (e.g., a year) or quantifiable outcomes, such as how many people participated at an event. While these numbers can be important, they are not enough to capture the impact of a project. For example, during Aquí Nos Cuidamos, we established partnerships with 10 community leaders in Puerto Rico who became our ambassadors. The value of these partnerships is not in the quantity, but the quality of those relationships: we earned the trust of 10 leaders and through them, helped meet the needs and priorities of 10 different communities. Science communicators must put greater focus on how to measure and study such outcomes so that funders can consider them in their definition of success. Another key change is ongoing funding for organizational capacity building. Financial support for operations or administrative assistance will advance the sustainability of ongoing endeavours that are leading inclusive science communication work.

Conclusion

The past 20 years of science communication have seen important progress towards inclusion, equity, and justice. In this commentary, I have reviewed some of those changes and demonstrated how culturally relevant science communication activities are part of a broad movement seeking to change the culture, research, and practice of science communication [Canfield et al., 2020]. I have drawn from my experiences with CienciaPR and as a science communication practitioner in the United States (where I reside and of which Puerto Rico is a colony), but I believe that my experiences offer lessons for the whole field to continue to address past and present exclusions and injustices and avoid future ones.

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