SCIENCE COMMUNICATION AND SCIENCE ADVICE REQUIRES SPECIFIC TOOLS – HOW CAN WE HELP EARLY CAREER RESEARCHERS

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Abstract

Science communication is at the heart of public outreach, science advice and science diplomacy, which researchers of all ages must engage in. We are mostly familiar with dissemination in scientific circuits, be it congresses, symposia, workshops or papers, however we are less equipped and familiar with communicating our science to the public, policymakers or funders. Communication of scientific methods, results, innovations and such is not only important to inform the general public of new advances, but also to provide policymakers with Science is a very specialized set of knowledge, data, idea sor proposals; however it can also be a marketable commodity in the form of science fiction books or movies, popular science blogs or news articles, documentaries and TV shows. It is estimated that more than half of science podcasts were produced or hosted by scientists, and over 75 % of them were aimed at general public (MacKenzie, 2019). However as of today there are no audience engagement metrics or no authority to peer review the information provided on the podcasts, making the general public vulnerable to misrepresented information by non-scientists, which could well explain the rise of pseudoscience and decline in trust in science. This was unfortunately widespread during the COVID-19 pandemic, where conflicting information was presented to the general public, often interfering with and slowing down public health interventions, and is still a challenging issue in dealing with advocating on how to combat the impending effects of climate change on the planet. It is therefore the duty of scientists and young academics to ensure that science outreach or science advice is mediated through credible science communicators in an informative and well-represented, peer-reviewed manner, both for the general public and policy-makers.In this light, we believe it to be critical to provide early career researchers with appropriate tools and guidance to present scientific concepts and developments to both general audience and to audience with specialized background, including policy makers, while maintaining scientific integrity and restoring trust in science. In this talk, we will present some best practices, offer different effective science communication tools, and discuss how different cultural gaps can be bridged via young researchers.

Keywords

Science Communication, Science Advice, Science Diplomacy, Public Health, Climate Change, Sustainability, Trust in Science, Pseudoscience

What is Science Communication and Public Outreach?

Public understanding of science is a critical cultural, economic and political issue at the science-society interface. Science communication is generally used to define the process of communicating science and scientific advances to non-experts, in the form of science blogs, science writing, scentific games, science videos, documentaries or podcasts, and even science fiction, as well as outreach and engagement activities such as science museums, science fairs and exhibitions. It aims to both inform and engage the general public in science and scientific approach, and to emphasize the broader relevance of science for tomorrow's society in the form of saving lives, creating jobs and promoting education. For the past two decades, Science, Technology, Engineering and Mathematics (STEM) or more recently Science, Technology, Engineering, Arts and Mathematics (STEAM) activities have been quite popular among high school students in order to increase interest in these disciplines. However, science communication or public outreach is not simply the act of inspiring next generation of researchers, but a more general platform for bringing together science education, science communication and science policy, and ensuring transparency in political decisions combining scientific expertise with public views and interests. There are two main aspects: public understanding, and public engagement. Thus, outreach can take a variety of forms, from science fairs in schools, to science exhibitions open to people of all ages, to documentaries, science fiction movies, science talks, and science advice to politicians.

What is Science Advice and Science Diplomacy?

Science advice and science diplomacy are concepts that overlap with science communication, only to a narrow and highly specialized audience of policy-makers and other actors - including non-governmental organizations (NGOs), think tanks, charities, foundations, or private sector organizations - at the local, regional, national or international level. Science policy is yet another term used for application of scientific knowhow and developments to public policies, hence acting as a bridge between scientists and the general public that benefits from scientific knowledge generated through informing decision-making authorities. This level of science advice can be provided to different actors through scientific reports, analyses or similar methods so as to liase more informed decision-making by various actors.

Governments and other decision-making or policy-making authorities need to understand science and scientific advances in order to make informed decisions. To be able to inform and direct policies in the light of scientific research, in addition to producing high quality research scientists must understand the process of policy-making and be accessible to policy-makers, ie they must be "networking" at the political level (Oliver & Cairney, 2019). Policy-related decisions are usually taken by local, regional, national or international level policy-makers on behalf of their constituents and the political landscape. Scientists can prefer to be "honest brokers", disseminating their research results in a timely and objective fashion, while remaining neutral, or "issue advocates", to actively direct a specific policy direction based on their research (Oliver & Cairney, 2019). There are also different formats and organization types of science-policy

interfaces, from ad hoc science policy platforms to highly structured organizations or academies. Regardless, effective science advisors have to provide evidence-based, objective and relevant information to policy-makers, while clearly relaying the intrinsic uncertainties in scientific research and the scientific process.

What Tools are Being Used / What Can be Used?

Dissemination of research output to the general public is also important for the public support of new policies; one such EU project, DEVOTES, used a variety of tools, from websites, newsletters and email campaigns to scientific publications, workshops and conferences (Mea et al., 2016). Networking with other EU projects was also utilized as a means of disseminating the results and greatly enhancing the overall impact of the research output. Whatever the means or tools, impact analysis should be employed in order to estimate whether key goals and performance indicators have been reached through the preferred mode of science communication.

Science communication and science diplomacy require overlapping but different tools due to their highly differentiated audience. Many universities have long initiated certificate or graduate degree programs on science communication, scientific writing, science policy or science diplomacy, teaching the fundamentals of these topics and introducing critical tools for these approaches. These programs can include a multitude of topics, including but not restricted to social media literacy, scientific writing, blogs or podcasts, scientific games, mobile apps, science videos and documentaries, scientific storytelling and science fiction. Public outreach and engagement can also take the more interactive format of science festivals, science museums or other STEM activities.

Podcasts represent medium for communicating scientific output to not only to the general public but also to other scientists, young and old, as a means of disseminating research output to scientific communities that may not necessarily have access to many academic conferences or scientific journals, in spite of the open access (OA) institutions (Quintana & Heathers, 2021). Therefore, similar skillsets for producing scientific podcasts can be fine-tuned for various types of audiences – non-experts, experts or policy-makers.

Scientific accomplishments can be exciting and groundbreaking, yet when these achievements are reported in scientific meetings it is usually in a relatively boring technical atmosphere, which may fail to captivate the interest of general public. Hence, effective science communicators have to learn to be good storytellers. People who are natural storytellers have the ability to liven up a party or a meeting, generate an emotional response from the audience, which captivates the listeners' interest, using anectodes, humor, personal experiences, and punch-line messages, essentially dramatizing their research (Dahlstrom, 2014; Green et al., 2018). TED talks started in 2006 as a one-off conference on Technology, Entertainment and Design, however due to widespread interest it soon became one of the most popular science outreach enterprises throughout the World, and it was soon followed by a grassroots initiative TEDx (TED, 2024). Using narratives and storytelling also makes the relayed information more persuasive to the audience, generating trust (Dahlstrom, 2014).

Storytelling is not only through literary means, one can also tell a story through music, art or dance; not surprisingly, Science journal has initiated Dance Your PhD contest in 2008 where students are encouraged to explain about their PhD work through dance and post it on YouTube (Science Journal, 2024).

Regardless of the format for their storytelling, scientists have to acquire skills on creative arts, visualization of information, written and oral comunication skillls. It has been discussed for quite some time that higher education institutions mush somehow integrate communication and public engagement skills to scientists' training, on global-interest topics such as public health, climate change, renewable energy and sustainability, among many others (Baram-Tsabari & Lewenstein, 2017). These include critical skills in basic communication skills such as speaking and writing, didactics, media training, language clarity, pedagogy and leadership among many others (Kuehne et al., 2014; Baram-Tsabari & Lewenstein, 2017). Alan Alda Center for Communicating Science was opened at Stony Brook University in 2009 by just such a mission, by the actor and activist Alan Alda, and is still one of the leading science communication institutions serving scientists, NGOs, government agencies and industry all over the world (n.d.).

It should be noted, however, that over-enlivening the achievements for the sake of popularity in mainstream media can also have unforeseen and unwanted consequences. Therefore while storytelling can relate the vividness of these achievements to the general public one should be careful not to mislead the audience.

Science advice and science diplomacy essentially follows similar toolsets, but for a more restricted and highly specialized clientele that requires this information for their decision-making processes. These are more in the form of scientific publications, scientific policy reports and white papers, conferences and other networking events. In the case of science diplomacy, another critical skill is communicating controversy in an objective and relevant manner (Oliver & Cairney, 2019). A scientific advancement or finding can also have a moral or ethical aspect that affects the public in general; depending on the political background, culture or history of the population or the individual values of the public, this can lead to varying responses or elicit different emotions that should be taken into account (National Academies of Sciences, Engineering and Medicine, 2017). Communicating the inherent uncertainty to policy-makers is also important in establishing trust in the post-truth era, particularly when such uncertainties are behind some of the controversies (van der Bles et al., 2019; National Academies of Sciences, Engineering and Medicine, 2017).

What is the Role of Young Scientists Around the Globe to Reestablish Trust in Science Through Effective Communication?

The main role of a good scientific Communicator is to facilitate the citizens' engagement with new developments in science and technology and to raise awareness of how science can contribute to the wellbeing of general public in the midst of great challenges facing the planet, while maintaining scientific integrity and re-establishing the trust in science

and scientists. Unfortunately, populism and the fame trap is a significant threat that science diplomacy and science communication actors as well as general public are facing in the post-truth era.

Misinformation is generally defined as initiating or propagating false information, which may or may not have initially been processed as valid (Cacciatore, 2021). Different studies were conducted to find means to combat the spread of such mis- or disinformation, one of which is rumor control, but another is the retractions or corrections, which are a normal aspect of science that can be easily misused. The current increase in (AI) can no doubt be used in these misinformation-combatting endeavors, but it should be noted that AI can just as easily be used to generate controversial or falsified data or information. Young generation of scientists should be extra cautious in the use of AI in their reports, as well as others', when communicating with the public. It should also be on every scientist's agenda to inform the general public as well as more specialized audiences such as policy-makers about the importance of fact-checking from multiple resources. This was particularly important in the COVID-19 period, when the lack of scientific information unfortunately led to multitude of non-facts being circulated without any means of fact-checking, which was quite aptly named "misinfodemic" (Krause et al., 2020). The mainstream media was flooded with "experts", public initially had no way of knowing who was a true expert vs not, science advice was slow due to extreme caution, and many politicians had to rely on information out there. In the case of the COVID-19 pandemic, this created a multi-layered problem due to the seriousness of the disease for both individuals and populations at large, the magnitude ot misinformation, and the trustworthiness of the fact-checkers in the face of high uncertainty and limits of knowledge.

More than a decade ago, the so-called Climategate scandal was triggered when a UK university's computers were hacked and the informal "lingo" among scientists was misrepresented and exploited by climate change deniers (Baron, 2010; McKie, 2019). This story was later made into a movie called "Climategate: science of a scandal" (IMBD, 2019). The other aspect that science communicators must bear in mind is that when you communicate your science through mainstream media, in a manner that is relevant and understandable by the general public, one is always in danger of turbulence in one's academic career, the scientists being misunderstood and often ending up having to defend themselves (McKie, 2019). It is important to establish communicator credibility and trust through scientific expertise; one drawback that should be noted here is the "percevied expertise", and the challenge of identifying whom one should trust (Fiske & Dupree, 2014).

Sharpening communication skills is extremely important both to bridge gaps between scientists from different fields in order to find solutions to tomorrow's challenges much faster, to inform the public and fight pseudoscience effectively, and to bring critical scientific issues and developments to light. It is our duty, therefore, to equip the young generation of scientists in the communications and diplomacy game, while it is the young scientists' duty to maintain the science and scientific integrity in all aspects of their communication to different audiences.

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