Science Societies

Communicating Your Story: Value of Diversifying Science Communications in Research

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> With the invention of the steam-powered printing press in the early 1800s by German printer Friedrich Koenig, the mass production of newspapers and books started. This made the printed word easily available to not just an elite class, but to a much wider audience. The widespread distribution of scientific books, journals, and magazines followed, revolutionizing science education and communication in the 19th and 20th century. The process was further revolutionized by the invention of the internet, which made scientific information easily accessible to the public, in any place and time. The internet has revolutionized how information is shared and consumed—a transformation particularly evident during the COVID-19 pandemic's critical public health communications, helping people adopt precautions and mitigation strategies.

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Science communication is a practice of sharing scientific knowledge with the public and helping them understand its importance and application in their lives. Science communication can occur through various media, such as written articles in magazines and blogs, audiobooks and podcasts, videos, infographics, public talks, workshops, and social media content. It can be carried out by a wide range of people and organizations, including scientists, professionals, freelancers, university press offices, and communication departments.

For example, popular talks and visiting lectures, which have been carried out since the 19th century in America, are an important part of science communication and today are often delivered through online platforms. Further, events such as debates, exhibitions, talks, and festivals have also been instrumental in shaping public science communication. Another important aspect of science communication is citizen science, performed by amateurs or professional scientists engaging the public through in-person or online interaction, to conduct surveys, research, or extension of technology and science. It is a very common and important tool in agronomy, crop science, and soil science to collect soil and plant samples, study the impacts of climate change, and transfer the new innovations to the farmers.

Moreover, social media can play a significant role in science communication, providing a platform for discussing scientific topics among diverse audiences, offering positive feedback to researchers, and helping the public engage with science. Various societies have encouraged the scientific community to maintain a social media presence (Tachibana, 2014). It has been found that 26% of social media users follow science accounts, demonstrating the public's interest in science and the need for accessible

scientific information (Funk et al., 2017).

However, science communication can be challenging, as the public may struggle to determine which information to trust. As scientific information evolves, journals can present conflicting results, or the information may be incomplete, yet the public is often eager for answers. Making informed decisions depends on the public's ability to process and evaluate the information they receive. For example, farmers need reliable information to make decisions on their crop selection, adopt suitable cropping systems, and maximize the returns while maintaining soil and plant health.

A major challenge in science communication is determining whether the public has sufficient understanding and scientific literacy to comprehend the information being communicated and to express their views as informed citizens on science-related issues. Further, many research and innovations are limited to the lab and library and do not extend beyond the scientific community. This leads to a significant issue, allowing non-expert individuals to fill the void and potentially misguide the public. Thus, scientists and graduate students can play an important role in science communications in public forums for the reliable and trustworthy dissemination of scientific knowledge and information.

In this article, we will review the importance of science communication, different media, and general guidelines for effective science communication.

Why Does Science Communication Matter?

Science communication in current time is more important than ever as we face challenges like global pandemics, food security, climate change, and sustainability. It helps people to understand the complex issues affecting their life in a more scientific

way, build their trust in science and the scientific community, and promote scientific literacy. For example, bridging the gap between research and its practical application is critical for driving progress in agronomy, crop science, and soil science. Science communication ensures that research findings are not confined to academic circles but reach the stakeholders who can implement them—farmers, policymakers, and the public.

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For instance, if you've developed a new technology on drought-resistant crops, explaining how it functions and its potential to increase yields with less water is essential for farmers to understand its value. Farmers and agricultural practitioners are often willing to adopt new technologies and methods if they can see the practical benefits for their operations. Effective science communication increases scientific literacy by helping farmers to understand the "how" and "why" behind research, empowering them to make informed decisions on farm management that lead to increased productivity and sustainability of agricultural systems.

Public perception often influences how quickly agricultural innovations are accepted or rejected. For example, genetically modified organisms (GMOs) have revolutionized crop production, reducing pesticide use and increasing yields. However, public skepticism surrounding GMOs has often slowed their adoption due to misinformation and a lack of clear, evidence-based communication. Thus, science communication plays a critical role in shaping these perceptions by demystifying the science behind innovations like GMOs and explaining their safety, benefits, and role in addressing global food security. When the public is well informed, they are more likely to support agricultural advancements that can improve food production and environmental sustainability as we can see in the case of Bt cotton (Azhar et al., 2021). Further, integrated pest management (IPM) can significantly reduce the use of chemical pesticides through adoption of biological controls, crop rotation, and selective pesticide use, promoting public health and sustainability. Better guidance through workshops, extension services, and online resources can ensure that farmers have the knowledge to implement these practices effectively.

Science communication can also influence government policies and societal shifts toward more sustainable agricultural practices. Policymakers rely on scientific evidence to craft legislation that supports innovation, environmental conservation, and food security. For instance, research demonstrating the benefits of the microbiome and cover crops in improving soil health has led to policy changes that encourage farmers to adopt these practices through different incentives and support systems. The *USDA Science and Research Strategy, 2023-2026: Cultivating Scientific Innovation* has labeled science communication as its priority strategy to improve awareness of scientific progress and policy related to food, feed, fuel, and fiber systems. Similarly, the National Institutes of Health also prioritizes science communication as their strategy to disseminate scientific progress on disease cure and drug trials. Thus,

science communication can shape broader societal understanding in the latest research and technologies and support for sustainability initiatives in agriculture and public health.

Trainings in Science Communication

While science communication is growing in importance, most scientists are still not trained in communicating their science to the public, which is regarded as less of a priority. Academic institutions are far behind in creating mechanisms to train scientists in science communication. Science communication encompasses a plethora of skills, such as creating short- or long-form content using text, audio, or video to educate audiences such as young students at schools or the general public.

Despite these different forms and audiences, the major goal remains learning how to communicate free of jargon. Scientists generally work in niche areas and share their science within their community. They are limited by who their audience is. Learning to communicate science to anyone in our vicinity is almost like learning a new language. The pyramid of sharing information is reversed. In an academic setting, it is common to move from an introduction to results, whereas, in science communication, one must explain the result first and why it's critical to hold the audience's attention. In an academic setting, it is common to move from an introduction to results, whereas, in science communication, one must explain the result first and why it's critical to hold the audience's attention.

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Graduate students, postdoctoral fellows, and early career faculty members are getting involved in learning the art of science communication formally. Whether or not these researchers become full-time science communicators, the training expands their understanding of the impact of their scientific question. Short-term training opportunities and workshops by scientific societies, student-run organizations, and professional development offices at institutions are filling the gap.

Scientific societies are uniquely positioned to improve public understanding of a particular field by developing communication skills of experts in their field. For example, the American Society for Biochemistry and Molecular Biology runs "The Art of Science Communication" wherein participants attend an eight-week virtual course to learn science communication. They also run an "Advocacy Training Program" to enable graduate students and postdoctoral fellows to get hands-on policy and advocacy training for three months virtually. The American Association for Advancement of Science (AAAS) runs two programs wherein they encourage scientists from all fields to participate in their science writing and policy-focused programs. The AAAS "Mass Media Science and Engineering Fellowship" trains undergraduates, graduates, and

postdoctoral fellows in science-writing careers by placing them in newsrooms across the nation. The AAAS "Science and Technology Fellowship" enables scientists to impact policy making by providing them a year-long assignment in different branches of the federal government. Our Societies—ASA, CSSA, and SSSA—also have science policy and communication initiatives and provide a two-day congressional visit opportunity to Capitol Hill for Society members (including students) to engage with congressional members on federal issues related to food, agriculture, and natural resources research and funding (https://bit.ly/3NKDCce).

Student-run organizations are also impactful in creating connections between students for science communication activities—whether they are local or national-level chapters. For example, the Communicating Science workshops for graduate students (ComSciCon) are run by graduate students for graduate students. They are fully funded by scientific organizations, non-profits, and universities. The workshops serve as a starting place for many students to improve their professional network, learn about careers beyond the lab bench, and network with science communicators. The national chapter has grown into several local chapters within the U.S., each serving a few states at once. This short weekend of training helps students narrow their interests, engage in their interests, and even lead initiatives within their institutions.

Science communication experts at university spaces are also expanding our understanding of how scientists can take their science to the public and create impact. The Civic Science Fellowship developed by Dr. Fanuel Muindi, a professor at Northeastern University, is one such example. The fellowship brings experts from diverse backgrounds to lead multidisciplinary projects at the interface of science and society. Dr. Muindi has also led an effort to develop a dashboard with training opportunities across the U.S. by institutions and non-profits. This is extremely useful

for anyone who wants to take a leap into the world of science communication to identify opportunities suitable to them.

Media to Communicate Science

Popular Science Books and Articles

Popular science books and articles are great tools for sharing scientific discoveries and knowledge with general audiences or non-specialists. They can be a source of inspiration and motivation, particularly for young people. For example, popular books like *Sapiens* by Yuval Noah Harari, *The Selfish Gene* by Richard Dawkins, *A Brief History of Time* by Stephen Hawking, and *Beating Back The Devil* by Maryn McKenna have shaped public conversations and discussions around science. Biographies of scientists can also serve as a form of science communication to the general audience, providing a historical narrative of the development of science and even new fields. The famous science communicator Carl Sagan once said, "Science is an essential tool for any society. And if the scientists will not bring this about, who will?" This highlights the crucial role of scientists in science communication as they are the ones who generate scientific information and make discoveries and inventions (Illingworth et al., 2014). Further, popular science articles in magazines like *Scientific American*, *The Atlantic*, *Science News*, and *New Scientist* are important in communicating the latest research and technology to the public community. *CSA News* and *Crops & Soils* are two science magazines from the Societies that are popular among scientists, advisers, and soils and agronomy professionals, providing the latest research and innovation in agronomy, crop and soil research, farming systems, and sustainable agriculture.

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Podcasts/Radio

Radio has been the easiest and cheapest method of science communication since its invention. As radio waves travel quickly, listening to news, including scientific updates, during coffee breaks or meals with family and friends was a common practice before the internet era. Radio has also been a powerful medium for science communication in remote areas worldwide. Radio also offers a space for meaningful conversations and can teach science and concepts to the public in a way they can easily understand.

The rise of podcasts has further expanded this format. Unlike radio, podcasts allow listeners to customize their listening experience at their convenient time. Many scientific societies and organizations have started their own podcasts to engage both the public and the scientific community, sharing research and discoveries in their respective fields. For example, podcasts like *Heredity* from the Genetics Society of America and *Field, Lab, Earth* from the Societies bring scientists who have recently published impactful research to share their findings in simple and accessible language. This has been instrumental in disseminating the research and knowledge for general audiences, students, and even scientists to stay up to date. Thus, both radio and podcasts have played an important role in initiating debates and discussions, making them effective tools for science communication.

Video/Documentaries

Videos, documentaries, and movies play a crucial role in science communication, particularly in helping to understand complex topics through visuals and creating effective ways to convey the message. This is especially important in areas of ecology, agriculture, and the environment. These resources can directly communicate with the growers on different aspects of crop management like diseases and pests and other abiotic and biotic factors. For instance, videos and documentaries have been successfully used by famous science communicator David Attenborough to disseminate knowledge about ecology and nature, gaining worldwide recognition and demonstrating the power of visual media in science communication.

Often, visuals are more effective than words in conveying the importance of nature and biodiversity, sparking curiosity in science among general audiences. For example, the Foldscope project, initiated by Dr. Manu Prakash, a professor from Stanford University, has gained global attention by allowing people to explore the microscopic world through a one-dollar microscope. Images and videos shared through such projects have helped the public to explore aquatic microscopic worlds, increasing public engagement and trust in science. Additionally, videos and documentaries have made the impacts of climate change more visible and compelling. This form of storytelling strengthens the message, leading to public participation and engagement in conservation and citizen science initiatives. Many research institutes and universities frequently share their research highlights and impacts through videos and documentaries.

Extension Services

Extension services play a pivotal role in translating scientific knowledge into practical applications, benefiting local communities. These structured mechanisms, involving

dedicated institutions and personnel, actively transfer research and information from land grant universities and government institutions to stakeholders, often farmers, crop advisers, and industries involved in agriculture. Through workshops, demonstrations, and on-site consultations, extension professionals facilitate the exchange of research-based information tailored to local needs.

Verbal communication is a key tool in this process, allowing educators to present complex scientific information in a clear and relatable manner. By engaging with diverse audiences through face-to-face interactions, field days, and community meetings, extension professionals can address specific concerns, answer questions in real time, and adapt their messaging to the local context. This personalized approach enhances understanding and retention of information while also fostering trust and long-term relationships between researchers and the public. Importantly, extension personnel work extensively to build rapport between two key stakeholder groups: researchers and farmers. This relationship facilitates a crucial feedback loop, allowing farmers' insights and experiences to inform and shape research programs. This bidirectional flow of information ensures that scientific endeavors remain relevant and responsive to real-world needs.

Social Media

Social media platforms have revolutionized how scientific knowledge is disseminated, offering a powerful channel for reaching diverse and global audiences. Instagram, Facebook, X, and other platforms allow researchers to share their findings, innovations, and insights in real time, extending the reach of traditional academic publications. These platforms play a crucial role in shaping public understanding of science by breaking down complex concepts into digestible, visually engaging formats that can be easily shared and discussed. The COVID-19 pandemic starkly illustrated this need as

chains of misinformation spread rapidly across social media platforms. This scenario underscored the importance of scientists actively engaging in various communication channels to counter misconceptions and ensure accurate scientific information reaches the public.

Citizen Science Projects

Citizen science is a growing area in science communication, serving as an important agent of change by catalyzing scientific innovations and raising public awareness about environmental and health issues. Citizen science refers to public participatory initiatives and programs where individuals contribute and collaborate with the scientific community. This collaboration brings diverse perspectives and valuable data, aiding in the analysis of scientific questions. For instance, several genetic disease projects involve people from various backgrounds, helping generate diverse data while raising awareness about these diseases. In the field of crop science, soil science, and agronomy, citizen science plays a critical role in science communication as well as in facilitating research initiatives and their success.

Due to the complexity of soils and crops, it is essential to study a diverse array of soils and plants to understand impacts of climate change and their adaptations. Making citizens aware of these issues can significantly contribute to conservation efforts and promote climate resilience and a sustainable future. For example, citizen science can help run awareness programs on new diseases, pest scouting, and the introduction of new varieties and techniques developed in different USDA and university labs. Several projects focused on watersheds and water bodies also rely on citizen science for conservation efforts and to facilitate research. Crop monitoring in stress-affected areas, aided by citizen scientists, can assist researchers in studying crop improvement. With the rise of invasive species, citizen science can engage in scouting

for new invasive pests and plants on time and report to the concerned agencies.

Strategy for Effective Science Communication

Tailoring the Message

Effective science communication starts with tailoring the message in simple and jargon-free structure. As we find difficulty in understanding research from completely different fields, the same thought process should be applied in science communication, especially when you are dealing with a general audience. It is a very common issue among the scientific community to use technical words and simplify the concepts, thus reducing public engagement with them. For example, when it comes to a research project that one is passionate about, it may be easy to speak about it in terms that one is comfortable with, but doing so can make it much more difficult for the audience to understand it.

A single topic can be explained in different depth and length of the presentation based on the target audience. It is typically good practice to avoid jargon or to take the time to define those terms in easy language at the beginning. For instance, acronyms should be explained well at the beginning when they appear and should be always presented with supporting context to make them sound less complicated. Further, it's important to consider the cultural, social, and geographical context of your audience to ensure your message resonates with them and doesn't hurt their sentiments and faiths.

Simplifying Without Oversimplifying

Science communication can mislead the audience when it is oversimplified without keeping the important details and contexts of the background information. As we know, many concepts and information overlap across different disciplines, and omitting important details and nuances can lead to a completely different meanings

and confusion among the audience. When giving a presentation, talk, or interview, it may be best to present the message at the simplest level. For example, the gist of the whole presentation or talk can be a simple message like which treatments yielded the best or a new discovery in soil structure while leaving out the methodologies, which may be unnecessary for the general audience. Sometimes, it may be easier to get lost in all of the small details rather than conveying the main message. The use of diagrams, infographics, and pictures also help simplify the complex concepts with fewer words, especially technical and jargon.

Storytelling

Storytelling is an important part of effective science communication for engaging audiences either through talks or writing with an emotional and compelling narrative. As we know, the human brain is more receptive to stories than facts and numbers. When talking about research, being passionate about it through storytelling can assist in getting technical details across to our audience. A good rule of thumb would be to craft a narrative: Frame a scientific message as a story with a clear beginning, middle, and end with a meaningful conclusion or takeaway message.

The key elements of storytelling are a strong character (focus of the research like protein, microbes, or any traits), key issues (specific environment or treatments or research question), and tools for overcoming the issues (connecting characters to the issues, techniques, and methodologies) with emotional touch (some compelling real-life story in its significance). For example, a movie is a perfect example of storytelling since it contains a story and characters that directly connects people through emotional touch. Through this process, one can highlight the problem (why it matters), the process (how science addresses it), and the solution (what the results are and why they matter). Being passionate about the work also helps in making it personal. Talking

about the people behind the science and their motivations can bring in the human-interest side as well.

Scientists should show how the topic relates to real-world challenges, especially in agriculture, food, and natural resource management. For example, while writing about the success story of any technology in climate resilience, it's important to explain the science and research behind it as well as connecting with people who benefited from it by explaining how it is going to improve their life and that of others.

Use of Audio-Visual Tools for Simplifying Science

One of the common assumptions in science communication is the deficit model, which focuses on bringing more information to the public so that better decisions can be made. The recent public engagement model says that knowledge is only one factor out of many that influences the people's response and decision. This is where the role of audio-visual tools becomes more important in helping people trust and believe in science and make informed decisions about their life, health, and the environment.

Some best practices for communicating science through videos, blogs, and podcasts include engaging multiple senses, focusing on quality, and keeping it concise. Incorporating visuals, images, sound, and movement make complex information more engaging. For example, images and videos of some environmental disasters can create a more serious narrative than words alone. Images of people and their lives also speak their voice directly to the audience without even needing to explain it. Sometimes, visuals can be confusing if they are not in high resolution or have too much detail in them. Ensuring clear audio and professional images with proper captions can bring more clarity and convey the proper message. Poor sound quality, shaky visuals, or low-resolution graphics can distract the audience from the main message and reduce

credibility. Further, complete information with clear and focused messages increases the effectiveness of podcasts and documentaries.

Engaging on Clear and Impactful Narratives Through Social Media

With the rapid development on social media, most of scientific information is shared and consumed online. For example, as of 2015, two-thirds of American adults used at least one form of social media and around 47% get science news online. This creates an opportunity to structure the information according to social media and audience groups. Some practical tips for making engaging scientific content include crafting concise and impactful messages typically with the inclusion of pictures or videos that enhance the effectiveness of science communication. Attention spans on social media are short. Leveraging hashtags and trends allows for reaching a wider audience.

Public Speaking and Presentations

Public speaking is one of the core skills in communicating science through interviews, lectures, or plenary talks. For example, the TED Talks are the most successful example of science communication with an emphasis on good speaking skills, presentation, and delivery. Engaging the audience during talks makes the communication more effective and impactful. As the saying goes, practice makes perfect—practicing presentation in front of a mirror for proper facial expressions and eye contact with the audience enhances the efficiency of public speaking whereas practicing in front of others can gauge your ability to speak with an audience. Further, engaging with the audience, through appropriate body language and expression, can help convey the message more effectively.

Diversifying Science Communication

As the scientific community continues to produce groundbreaking research, it is crucial that the community matches this progress with equally innovative communication strategies. By embracing a diverse array of communication tools and platforms, scientists can ensure that their valuable work does not remain confined to academic journals but instead becomes an integral part of public discourse and the decision-making processes. This diversification involves leveraging various platforms such as digital media, multimedia content, public events, and collaborations with artists and policymakers. By embracing these diverse channels, researchers can reach broader audiences, adapt to different learning styles, and increase their work's visibility and impact. This approach not only helps in addressing misinformation more effectively, but also bridges the gap between scientific discoveries and their practical applications in society. As science progresses, matching this advancement with innovative communication strategies ensures that valuable research becomes an integral part of public discourse and decision-making, reinforcing science's role in shaping our collective future.

Science communication also benefits greatly from diversity as diverse communities bring new ideas, methods, and explanations to the table. Engaging a wider array of voices in the scientific conversation helps to address complex challenges from multiple perspectives, fostering innovative solutions. This diversity also encourages interdisciplinary collaboration as individuals from different cultural, educational, and professional backgrounds contribute to expanding the scope of scientific inquiry. Improving communication with underrepresented communities is essential for fostering inclusivity in science. By adopting inclusive communication strategies, scientists can build trust and stimulate curiosity in these communities, making science more accessible and relevant to their daily lives. This, in turn, can inspire behavioral

changes that contribute to positive societal outcomes, such as adopting conservation practices or supporting public health initiatives.

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As scientists, if we are not out there telling our stories and advocating for our work, no one else will do it for us. Active engagement in science communication not only helps to disseminate true scientific findings, but also inspires a new generation of scientists and reinforces public faith in good science. It is our responsibility to step up and use our collective voice to address misconduct and misconceptions in science, protecting the ethics of scientific communication.

Conclusions

With the rise of global pandemics, climate change, environmental degradation, and deteriorating public health, public decisions rooted in science have become more important than ever. Further, the easy access to the internet and social media have created a high risk of spreading misinformation, risking people's lives. Thus, it is important to create trust and belief in science among the public community. The scientific findings and innovation are exciting and inspiring, but it can be challenging as

well for people to understand their true meaning and impacts. This creates a space for science communication to inform the public in easy and simple language, relating with their life and sentiments. Science communication through diverse tools and voices brings significant power to transform people's lives and their community. From agriculture and conservation efforts to public health assessment, science communication serves as the medium for engagement between the scientific community and the public. Understanding its role in society development, U.S. government agencies have undertaken several initiatives to foster science communication and public engagement. Further, more funding and training of the scientific community on science communication can open new milestones in the transformation of society through science and technology, achieving a sustainable environment and future. Empowering the public through science communication and engagement influences society's voice and government policies on different environmental and health issues, thus helping to create a better society.

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Connecting With Us

If you would like to give us feedback on our work or want to volunteer to join the ASA, CSSA, and SSSA Graduate Student Committee to help plan any of our activities, please reach out to Jessica Bezerra de Oliveira (jbezerra@ksu.edu), the 2025 chair of the committee!

If you would like to stay up to date with our committee, learn more about our work, contribute to one of our CSA News articles or suggest activities you would like us to promote, watch your emails, connect with us on X (@ACSGradStudents) and Facebook (ACS.gradstudents), or visit: agronomy.org/membership/committees/view/ACS238/members, crops.org/membership/committees/view/ACS238/members, or soils.org/membership/committees/view/ACS238/members.

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