How to Communicate Stigmatized Science Topics in Rural and Urban Communities

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Abstract

Resistance to stigmatized scientific issues, including climate change and vaccines, is commonly rooted in political perspectives, cultural beliefs, misinformation, and distrust of scientific organizations (Philipp-Muller et al.). This resistance varies significantly between rural and urban communities in the United States, making effective science communication a complex challenge (Hunter). Despite growing interest in improving public understanding of science, many communication strategies fail to address the unique social, emotional, and ideological barriers that different communities face (National Academies of Sciences). This literature review aims to identify the most effective methods for communicating stigmatized science topics in both rural and urban settings by examining existing research on trust, identity, and communication practices. By analyzing academic studies, the paper will compare communication strategies across different communities. Practical recommendations will be proposed that help scientists, educators, and policymakers bridge the gap between scientific knowledge and public acceptance.

Introduction

Stigmatized science topics such as climate change and vaccines often face public resistance rooted in political beliefs, cultural values, misinformation, and mistrust in scientific institutions (Philipp-Muller et al.). Although 76% of Americans express at least a fair amount of confidence in scientists to act in the public's best interest, this is a notable decrease from the 87% reported in early 2020 (Funk). Trust also varies across political lines, with 88% of Democrats reporting confidence in scientists compared to 66% of Republicans (Tyson). Many Americans, particularly those that identify as conservative, are skeptical of scientists' roles in policymaking and question their objectivity (Tyson). Only 45% of U.S. adults consider scientists to be "good communicators," and nearly half believe scientists feel superior to others (Tyson). Research shows that public rejection of scientific information often results from mismatches between how messages are delivered and how individuals process information; people are more receptive to messages that align with their epistemic style, such as whether they prefer abstract or concrete framing (Philipp-Muller et al.). This insight highlights the need for targeted communication strategies that account for regional, psychological, and cultural differences, especially between rural and urban communities where trust, identity, and communication norms vary widely (Hunter).

In light of the differences mentioned above, this paper focuses on rural and urban communities to explore how communication strategies can be tailored to address their unique challenges and perspectives. This literature review aims to fill that gap by comparing existing studies on communication approaches in rural and urban settings. By offering practical recommendations for scientists, educators, and policymakers, this paper seeks to improve engagement with these communities on controversial scientific issues.

Methods

This review uses a comparative approach to analyze academic sources that examine how science topics are communicated in rural and urban communities across the United States. Sources were selected from peer-reviewed journals, public research institutions (such as Pew Research Center and the National Library of Medicine), and educational studies, with a focus on public trust and science communication. Key themes were extracted and categorized by geographic setting (rural vs. urban) to identify communication strategies specific to each context. Emphasis was placed on studies that discussed trust-building, message framing, audience identity, and community engagement. The goal of thematic analysis is to find patterns across the literature and compare strategies that may help scientists, educators, and policymakers communicate more effectively with diverse populations (Jucan and Jucan).

Results

Effective rural science communication relies on intentional, relationship-based strategies that align scientific goals with community values. Research on rural science education shows that incorporating local knowledge into instruction, such as agriculture, land stewardship, or weather observation, reduces skepticism by making science directly relevant to everyday life (Avery and Kassam). When families see their expertise reflected in lessons, they are more likely to view scientists and educators as trustworthy collaborators rather than outsiders.

Communicators also strengthen trust by using plain, culturally familiar language and drawing on local examples, rather than relying solely on abstract or technical explanations. Studies of rural school leadership reinforce this point, showing that credibility develops through personal interaction and visible investment in community life, whether through one-on-one conversations or participation in local events (Preston and Barnes). Similarly, medical educators working in rural settings use distributed community-engaged learning (DCEL) to form long-term partnerships, demonstrating that science communication is most effective when it is sustained over time rather than limited to one-off outreach efforts (Strasser). At the same time, studies of urban-rural divides in science attitudes reveal that beliefs of traditionalism and conservatism held in rural communities often contribute to lower feelings of warmth toward scientists (Krause). Missteps in COVID-19 health communication highlight this challenge. Rural communities sometimes rejected public health messages they perceived as politically motivated or

disconnected from local values, leading to lower vaccination uptake despite scientific consensus (Bromme et al. 7).

Overcoming this challenge requires communicators to frame messages in ways that resonate with rural priorities, such as taking care of their land, economic security, or community health. For example, climate science communication can emphasize the tangible effects of shifting weather patterns on crops and local economies, while public health messaging can highlight the immediate benefits of vaccination for family and community well-being. These strategies demonstrate that effective rural science communication is not only culturally grounded and politically aware but also built on mutual trust and sustained engagement. By listening to local voices, framing messages in ways that connect with lived experiences, and maintaining ongoing dialogue, scientists and educators position themselves as partners working alongside communities to address shared challenges.

Effectively communicating science to urban communities requires a systemic and relationship-centered approach that recognizes the complex social and economic contexts shaping learning environments. Building authentic, long-term relationships grounded in trust and empathy is essential, as communication is most impactful when it engages community members and students as active participants rather than passive recipients (Moscovici 2009). Urban science education benefits from empowering all community members, including teachers, administrators, students, and families, by sharing power and encouraging critical thinking and inquiry-based learning, which fosters ownership and autonomy in the learning process (Hodges 1996). Additionally, aligning efforts across multiple levels, from classroom practices to district policies, ensures cohesion and prevents disjoined initiatives that undermine progress (Hodges 1996). A critical dimension of urban science communication involves addressing science mistrust, which can emerge from historical inequities, sociocultural beliefs, and exposure to misinformation. Research highlights that students and community members are better able to engage with science when they are taught to critically evaluate information for credibility, bias, and conflicts of interest, and to communicate scientific knowledge effectively across diverse audiences (Nasr 345–56). This includes analyzing media coverage, distinguishing peer-reviewed sources from non-peer-reviewed ones, and translating scientific findings into culturally relevant and accessible formats (Nasr 352–55). Furthermore, understanding the local context and youth experiences in urban communities can reveal how inequitable resource distribution shapes perceptions of science, allowing educators to help in a way that is responsive to community priorities while fostering trust and collaborative inquiry (Barton 31–33). Providing teachers with adequate resources, safe learning environments, and professional development opportunities that promote reflection, collaboration, and science literacy further supports effective science communication in urban settings (Hodges 1996).

COVID-19 illustrated both successes and failures of this approach. For example, in many urban areas in Germany, transparent, science-based health campaigns initially boosted public

trust in experts. Nearly three-quarters of Germans reported increased confidence in science during early 2020 (Bromme et al. 2). At the same time, inconsistent messaging and political polarization led to skepticism in some groups, demonstrating how quickly trust can erode without coordinated, community-centered communication (Bromme et al. 15). Overall, a comprehensive, culturally responsive, and participatory strategy grounded in critical evaluation, transparent communication, and relationship-building is key to engaging urban communities in meaningful science learning and dialogue.

Key differences between urban and rural communication strategies arise primarily from the distinct social dynamics, community structures, and resource availability inherent in each setting. Rural communication emphasizes deep, trust-based relationships cultivated through long-standing social ties and community involvement, often relying on informal, face-to-face dialogue that respects local knowledge and cultural values (Moscovici 2009). In contrast, urban communication must navigate larger, more diverse populations where stakeholder cohesion is more challenging and requires systemic coordination across multiple institutional levels such as schools, districts, and communities (Hodges 1996). Urban strategies prioritize empowering students and educators as transformative intellectuals who critically engage with science inquiry amid complex power relationships, while rural strategies often focus more on personalized, context-specific messaging rooted in established networks (Moscovici 2009, Hodges 1996). Additionally, urban settings face heightened challenges related to resource constraints and safety issues, necessitating structural support and professional collaboration that is less commonly emphasized in rural approaches (Hodges 1996). Thus, while both urban and rural communication strategies value trust and local relevance, urban communication demands broader systemic alignment and adaptability to diverse, dynamic populations, whereas rural communication thrives on intimate, community-centered engagement (Moscovici 2009).

Discussion

This literature review reveals that effective communication of science topics requires distinct approaches tailored to rural and urban communities. While much of the paper centers on science communication broadly, it acknowledges that stigmatized topics present unique challenges due to political beliefs, cultural values, and mistrust. In rural areas, trust is built through sustained, personal relationships and culturally sensitive dialogue within long-standing community networks. Urban communication demands systemic coordination, inclusivity, and empowerment of diverse stakeholders across institutions. These differences highlight that resistance to scientific messages is deeply intertwined with local identities and social structures, meaning a single communication strategy cannot serve all audiences equally. The findings emphasize the importance of long-term engagement and culturally relevant messaging to foster trust and understanding. However, limitations include a lack of extensive exploration of how sudden crises like COVID-19 reshape communication. Both successes, such as early trust in science, and misfires, such as inconsistent public health guidance or digital fatigue from

excessive technology use during the pandemic, demonstrate that effective communication during emergencies requires flexibility and transparency (Bromme et al. 3, DeFilippis et al. 5). By integrating these lessons, communicators can better prepare for future crises that demand rapid but trustworthy distribution of science information.

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