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Engaging Water Experts: A Qualitative Exploration of Kansas Water Science Communication and Outreach

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Abstract

Water resources are essential yet increasingly vulnerable to overuse. Despite the importance, public understanding of water issues remains limited, often due to communication barriers between scientists and diverse audiences. This study addresses this gap by exploring how water scientists in Kansas communicate their science, perceive water challenges, and collaborate with interdisciplinary teams. Thematic analysis was used to uncover key insights from 21 qualitative interviews. Findings revealed that water experts regularly engage with diverse audiences and collaborate across disciplines; however, most lack formal communication training. Based on these results, it is recommended that organizations partnering with water experts develop training programs to enhance communication skills. These programs should emphasize audience engagement, message clarity, and collaboration to strengthen the public's understanding of water science. Future research should further explore experts' perception of Kansas water issues and how these interpretations may influence their communication efforts.

Keywords

Water, Science Communication, Multidisciplinary Collaboration, Public Engagement

Cover Page Footnote/Acknowledgements

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Introduction

Water science is a critical field of study in Kansas, a state characterized by its vast plains and a strong agricultural economy that depends heavily on water for irrigation, livestock, and urban demands (Kansas Water Office, 2022). As water demand rises, effective management is crucial for sustaining the economy and resolving key issues such as water quality, drought, and the impact of agricultural practices. Kansas State University' Next-Gen strategic plan identified several critical issues facing the state of Kansas, with water sustainability designated as a high priority for advancing a more sustainable future (Kansas State University, 2023). Addressing these challenges is essential to ensuring long-term water accessibility (Kansas Geological Survey, 2023; Kansas Water Office, 2022). The American Association for Agricultural Education (AAAE, 2023) emphasizes the importance of advancing public knowledge of agriculture, natural resources, and food systems to support informed decision-making. Understanding how water scientists communicate is essential to achieving this goal, as effective science communication equips audiences with the knowledge they need to make informed and responsible decisions about water-related issues.

The High Plains aquifer is a crucial water resource supporting eight states, including Kansas (Sophocleous, 2010). The Ogallala Aquifer—its largest and most well-known component—accounts for roughly 80% of the system. Additional smaller formations, such as the Dockum Aquifer and Brule Formation, support the High Plains Aquifer system (Sophocleous, 2010). Fostering public understanding of water resource depletion and the importance of conservation is vital to protect Kansas's future water supply (Kettle et al., 2007). However, while advancements in water science have improved scientific understanding of water resources, communicating these findings effectively to the public and policymakers remains challenging (Sophocleous, 2010).

The importance of water conservation in Kansas is further compounded by a widespread lack of awareness about the complexity and vulnerability of water systems. The technical nature of water science creates a barrier for the public, as specialized language often hinders understanding (Nelkin, 1996; Tanner, 2004). Despite the urgent need for sustainable practices, water science remains a complex field that is often inaccessible to the public, resulting in a communication gap (Burns et al., 2003; Metcalfe, 2019). Effective water science communication is essential to bridging this gap, enabling the public to make informed decisions and take action to conserve water (Baram-Tsabari & Lewenstein, 2017).

Water literacy has become increasingly important and identified by many as a critical component to include in educational curriculum (Boon, 2024; Mostacedo-Marasovic et al., 2022; Su et al., 2011). Components of water literacy can include local knowledge (McCarroll & Hamann, 2020), water availability concepts (Johnson & Courter, 2020), water usage, water quality impacts, and water shortage implications (Su et al., 2011). Though water literacy is typically focused on formal education settings, informal learning through experiences such as extension programming, community workshops, and educational events can also increase water literacy. This increased water knowledge can also positively impact general water behaviors and actions (Dean et al., 2016; Yu et al., 2021).

Conceptual Framework

The conceptual framework for this study is grounded in the Theory of Planned Behavior, Social Cognitive Theory, and science communication models. The Theory of Planned Behavior (TPB) was applied to examine water experts' perceptions and experiences. The Social Cognitive Theory (SCT) was used to identify factors that influence their communication practices. Science communication models provided a lens for understanding how scientific knowledge is conveyed to public audiences.

This combination of theories and models was selected to capture the dynamic nature of water science communication. Research and interview questions linked to TPB focused on perceived behavioral control and communication intentions, including participants' training and their sense of capability. Questions tied to SCT explored observational learning of other's communication tactics and their self-efficacy in adopting or adapting these behaviors. The science communication models focused on dialogue and participatory approaches, which were used to examine how experts engage with audiences and incorporate stakeholder perspectives into the communication process. Additionally, TPB and SCT help explain how experts come to engage in communication in the first place. Observing peers successfully interacting with public audiences can strengthen experts' confidence to attempt similar behaviors, while attitudes toward communication, perceived norms, and perceived control shape their intentions to participate. These theoretical perspectives, together with communication models, illustrate how confidence, norms, and motivations influence both the decision to communicate and the approach selected.

Theory of Planned Behavior

The Theory of Planned Behavior derived from the Theory of Reasoned Action by Icek Ajzen in 1991 (Ajzen, 2020). A central factor in the theory is the individual's intention to perform a given behavior (Ajzen, 1991). TPB is used to predict individuals' intentions to engage in behavior at a specific time and place. Individuals' actions can depend on motivation and ability, also known as intention and behavioral control (LaMorte, 2022b). TPB is comprised of six constructs: attitudes, behavioral intention, subjective norms, social norms, perceived power, and perceived behavioral control (Ajzen, 1991). Among these, perceived behavioral control (PBC) was a focus in this study. Ajzen (1991) defines PBC as individuals' perception of the ease or difficulty of performing a behavior.

Social Cognitive Theory

Bandura's (1986) Social Cognitive Theory (SCT) is comprised of six constructs: reciprocal determinism, behavioral capability, observational learning, reinforcements, expectations, and self-efficacy. This theory exists in social contexts with dynamic interactions of person, environment, and behavior, with an emphasis on social influence (LaMorte, 2022a). People are not solely shaped by internal forces or external factors but by a combination of behavior, environment and cognition (Bandura, 1986). Through observational learning, people adopt behaviors by observing others, avoiding trial-and-error processes (Bandura, 1986).

Science Communication Models

Three major science communication models are deficit, dialogue, and participatory science communication (Metcalfe, 2019). The deficit model covers the spread of scientific knowledge (Bartock, 2015). Dialogue, also known as the public understanding of science, focuses on two-way communication about science (Bartock, 2015). Participatory science communication refers to science in society. The participation model of science communication focuses on connecting the public with science experts to collaborate (Bartock, 2015).

This study focused primarily on dialogue and participatory models. The dialogue model was selected as water experts are often in a position where they must relay scientific information to general audiences in lay terms (Baram-Tsabari & Lewenstein, 2017). Casini and Nerseini (2012) describe the dialogue and participatory models jointly as approaches that move beyond one-way communication by fostering mutual exchange and collaboration between scientists and the public. These models complement each other by both incorporating views and feedback from stakeholders to ensure research outcomes align with the needs of those impacted by the research (Bartock, 2015). The dialogue model alone does not allow for participation of stakeholders in the scientific process. Therefore, examining the two models together highlights how stakeholder input can be integrated with expert knowledge to improve communication and guide research in ways that are more responsive to societal needs.

Literature Review

The following literature review examines existing research related to water resources, the specific context of water resources in Kansas, and principles of science communication.

Water Resources

Water is a vital component of agricultural operations, supporting the health and growth of plants and animals. Agriculture is responsible for nearly 70% of freshwater use (United Nations World Water Development Report, 2024). Inefficient irrigation practices further contribute to the depletion of water resources (Foley et al., 2011). Foley et al. (2011) examine the challenges of meeting global food demand while minimizing environmental degradation and advocating for sustainable agriculture practices. The challenges associated with water quantity, quality, and agricultural use highlight the need for sustainable management strategies to ensure equitable access to this vital resource for current and future generations.

Water Resources in Kansas

Western Kansas experiences dry conditions, receiving significantly less rainfall compared to the rest of the state, a factor contributing to groundwater depletion and influencing agricultural practices (Kettle et al., 2007). Water availability in Kansas is influenced by seasonal and annual variations in precipitation, with drought periods exacerbating strain on both surface and groundwater resources. Climate change is likely to alter precipitation patterns and increase temperatures (Steward et al., 2013). Unpredictable rainfall paired with rising temperatures can lead to higher evaporation rates and a reduced water supply. These climatic variations significantly impact agricultural practices, which are heavily reliant on the state's primary water source.

Kansas relies on the Ogallala aquifer, a vast groundwater reservoir that provides 70-80% of the state's water needs, predominantly for irrigation (McGuire, 2014). Agriculture is the largest consumer of water in the state; irrigation accounts for 85% of Kansas’ total water usage (Kansas Department of Agriculture, n.d.). Given the amount of water agriculture requires, Kansas heavily relies on management strategies and policies to guide the state’s water use.

The United States Geological Survey has found that the level of depletion varies throughout the High Plains aquifer. In a 2013 report, the water level dropped an average of 15 feet over the entire aquifer since the 1950s, with about a 2-foot decline from 2011 to 2013 (McGuire, 2014). However, local variation was significant, with some areas experiencing a rise of up to 19 feet, while others recorded declines of as much as 44 feet. It was also found that the recoverable water in the aquifer is about 2.91 billion acre-feet. When looking at pre-development statistics, this shows a decline of around 286.4 million acre-feet (McGuire, 2014).

Several programs and organizations, both within and outside of Kansas, have worked toward finding a solution to the arising issues. For example, the 2003 Ogallala aquifer Program, a collaborative research initiative, was implemented in Kansas to provide a sustainable future with the aquifer (Hornbeck & Keskin, 2011). Another entity is the Kansas Water Office, which works closely with Kansas water users by creating a Water Plan that includes data, guidelines, and management practices that can be communicated to the public (Steiner et al., 2021).

Water Science Communication

Science communication connects the public with scientific knowledge. It is defined as the process of sharing scientific knowledge with practitioners, peers, or the public to promote awareness, enjoyment, and understanding of scientific concepts (Burns et al., 2003). According to Gilbert and Stocklmayer (2012) the primary goal of science communication is to enhance scientific literacy. Additionally, it can help guide decision-making processes (Baram-Tsabari & Lewenstein, 2017; Fischhoff, 2013). Effective science communication provides the audience with the necessary information to make informed decisions. Despite its critical role, science communication faces several obstacles that can limit its effectiveness.

While effective science communication is essential across many disciplines, communicating water science can present distinct challenges that require tailored approaches. Water science communication conveys knowledge and research to diverse audiences, including the public, industry professionals, and educators. This type of communication often integrates scientific information with policy perspectives and public engagement, aiming to address complex water issues (Corner et al., 2018).

Effective science communication strategies are crucial to facilitate understanding between scientists and the public. Different media platforms can help serve a specific purpose in scientific communication. For example, Martin and MacDonald (2020) conducted a social media analysis that discovered Instagram supports visual and personal content, such as selfies and short videos, which encourages a conversational tone. Conversely, Twitter is more commonly used to share short, timely information, making it more useful for sharing timely scientific findings (Martin & MacDonald, 2020). Knowing this can help experts strategically craft a media dissemination plan to share information.

Scientists can use a variety of communication approaches to connect with their audience. Dahlstrom (2014) explains that narratives effectively illustrate cause-and-effect relationships to keep readers engaged, offering examples such as conversations, testimonials, case studies, and television programs. However, Dahlstrom (2014) notes the downsides, including the risk of oversimplifying or misrepresenting scientific information. As narratives use storytelling to foster engagement, message tailoring can be used to adapt communication strategies to connect with specific audiences (Burns et al., 2003; Dahlstrom, 2014). Burns et al. (2003) suggests experts should not only tailor the content of the message but also the medium. While these play a critical role in effective communication, understanding public opinions and attitudes can enhance the impact of the message.

Clear communication about water science is crucial for raising awareness of issues like scarcity, pollution, and impacts of climate change. By fostering informed attitudes toward water management, communication can build long-term, trust-based relationships (Dean et al., 2016). Dean et al. (2016) highlight the importance of community engagement in water management, emphasizing the need for collaborative approaches to address water-related challenges. Building on the importance of trust and informed attitudes in water management, it's also essential to consider the underlying factors that shape public perspectives. Core values, such as security and equality (Maio, 2016) along with their political ideologies (Corner et al., 2014) drive people's views on scientific topics, shaping how they interpret water scientific science (Corner et al., 2018). Corner et al. (2018) suggests framing the message to align with the values and interests of audiences can make it more engaging and impactful. This research highlights that people's values and political views have a greater impact on their attitudes about climate change than their level of scientific knowledge (Corner et al., 2018). Therefore, aligning water science communication with widely shared public values can improve the chances of effectively conveying scientific messages.

Purpose

The purpose of this study was to gather initial insights into water scientists and subject-matter experts' perceptions of water challenges and solutions in Kansas, their experiences communicating water science with public audiences, and their experience with working on collaborative, multidisciplinary teams for water science research and communication. The following research questions (RQs) guided the study:

> RQ1: How do water experts perceive and utilize communication resources and knowledge?
>
> RQ2: How do water experts engage with communities to foster collaboration and shared understanding of water science?

Methods

Design

This study utilized an exploratory qualitative design to answer the research questions. This research design is appropriate when the study aims to explore and understand people's experiences and perspectives. Qualitative research design encourages a data collection environment where the researcher acts as the primary instrument (Hatch, 2002). Exploratory qualitative research allows data to emerge from the participants while respecting the uniqueness of each situation (Ormston et al., 2013). Prior to conducting the research, approval was obtained from the Kansas State University's Institutional Review Board (IRB). Guidance for the qualitative design came from multiple theoretical perspectives—including the Theory of Planned Behavior, Social Cognitive Theory, and science communication frameworks—which informed how we explored participants' intentions, learning experiences, and methods of engagement.

Participants

Participants were recruited using a non-probability purposive sampling technique. Purposive sampling is used to find participants with a specific set of characteristics (Rai & Thapa, 2015). The criteria for this study were based on career paths and areas of research focus, including those in positions focused on hydrology, water policy, water science, and other relevant fields. Based on these parameters, the Google search engine and preexisting lists were used to select 40 water experts. For this study, experts included researchers, faculty, and extension professionals. Of the 40 experts, 21 agreed to voluntarily participate in the study. Including experts with diverse communication roles and experience levels aligned with TPB and SCT, emphasizing how attitudes, perceived norms, and learning shape communication behavior.

The participants included water experts from 15 organizations across Kansas. Their work focuses on a range of disciplines, including data collection, policy creation, outreach, and education. Participants represented diverse areas of expertise, such as education, engineering, research, and outreach. After conducting the interviews, all personal identifying information (PII) was removed to de-identify the data and participant numbers were assigned. Participant information, including Kansas region and area of focus, is presented in Table 1.

Table 1

Overview of Participant Demographics

Participant Number	Kansas Area	Area of Focus
1	Northeast	Natural Resources
2	Northeast	Hydrology
3	Northeast	Water Policy
4	Northwest	Education/Biology
5	Northeast	Advocacy
6	Northeast	Policy/Water Rights
7	Northeast	Wastewater/Bioenergy
8	Southeast	Aquatic Science
9	Northeast	Geology
10	Northeast	Agronomy
11	Northeast	Water Quality
12	Northwest	Advocacy
13	Southwest	Groundwater
14	Northeast	Water Storage
15	Southeast	Aquatic Science
16	Northeast	Storm Water
17	Northwest	Groundwater
18	Northeast	Education - Engineering
19	Northeast	Conservation
20	Northeast	Natural Resources
21	Southcentral	Groundwater

Participants were categorized by Kansas region using established K-State Research and Extension boundaries (K-State Research and Extension [KSRE], 2025). Additional characteristics such as geographic location and professional focus were included to capture the diversity of expertise and positionality that may influence how water experts practice communication.

Data Collection

To address the research questions, the research team used qualitative, semi-structured interviews with 21 experts in the summer of 2024. The interview questions focused on overarching categories, including involvement in science communication, communication challenges, stakeholder interaction, and collaborative efforts. Interview questions were informed by TPB constructs (attitudes, subjective norms, and perceived behavioral control) and SCT concepts such as observational learning and self-efficacy. Science communication models further guided the development of questions aimed at examining experts' use of deficit, dialogue, and participatory approaches. The interview protocol included questions such as: How did you first become involved with water science communication? What are some challenges you have faced while communicating water science and what solutions have you seen? All participants provided informed consent, and measures were taken to ensure their confidentiality and well-being throughout the study. Each interview was conducted via Zoom and lasted 45-60 minutes. The audio was recorded and transcribed using Zoom features.

Data Analysis

The researchers reviewed transcripts against the audio recordings to ensure accuracy and applied necessary edits. The researchers employed qualitative thematic analysis to identify and report patterns in the data (Braun & Clarke, 2006). Initial inductive codes were generated using open coding, which allowed concepts to emerge directly from the data (Glaser & Strauss, 1967). Two transcripts were initially coded by two members of the research team to align understanding of the coding framework. During this co-coding phase, the researchers independently coded the same transcripts and then met to compare codes, discuss discrepancies, and collapse or refine overlapping codes to develop a preliminary codebook. Following this, the primary researcher independently coded the remaining transcripts. Example codes included interdisciplinary collaborators, communication practices such as audience segments and strategy, communication training and learning, time constraints, and advice for future efforts. During the next stage, axial coding was used to connect related concepts and explore how they contributed to the broader phenomenon under study (Glaser & Strauss, 1967). These codes were refined into overarching themes, which were reviewed and confirmed by the research team to establish validity. Throughout the process, the constant comparative method was employed to analyze the data, allowing coding and analysis to occur simultaneously so that emerging themes were continuously tested and refined against the data (Conrad et al., 1993; Taylor & Bogdan, 1998).

Positionality

The research team is made up of one faculty member and two students in the Department of Communication and Agricultural Education. The faculty member specializes in science communication research related to agricultural and natural resources contexts. The graduate and undergraduate student researchers both had agricultural backgrounds in the livestock sector but no prior experience in water science. This positioned them simultaneously as insiders to agriculture but outsiders to water governance, which informed the questions they asked and the connections they noticed in participants' accounts.

Trustworthiness & Transferability

Before data analysis, the research team established a common coding framework by collaboratively analyzing 10% of the data, two transcripts, ensuring agreement on the approach. This preliminary step was crucial for enhancing trustworthiness, as it allowed all team members to align their understanding of thematic categories that would guide the analysis (Braun & Clarke, 2006). To further strengthen transferability, rich, thick descriptions were to convey results, enhancing the depth and context of the findings (Creswell & Creswell, 2018). Throughout the research process, multiple meetings were held to discuss findings and ensure consistency. These collaborative discussions played a vital role in maintaining trustworthiness, by providing opportunities for members to voice opinions. Upon the analysis's completion, codes were cross-checked to confirm the organization of the findings. This rigorous process further solidified credibility by ensuring that codes were applied consistently across all transcripts.

Findings

To guide interpretation of the findings, three themes are presented and aligned with the study's research questions. In relation to Research Question 1, one theme captures how limited formal communication training prompts experts to rely on experiential learning and peer support. Two additional themes address Research Question 2, describing how water scientists adapt their communication for diverse audiences and how the interdisciplinary context of water research shapes collaborative practices. Collectively, these themes illustrate how water experts develop communication skills, engage communities, and navigate cross-disciplinary work within the water science sector.

RQ 1: How do Water Experts Perceive and Utilize Communication Resources and Knowledge?

Limited formal communication training leads water experts to rely on experiential learning and peer collaboration as primary pathways for developing communication skills.

Many water experts shared they do not have formal training in the field of communications. Most expressed their reliance on 'on the job' learning to help them with their communication tactics. Participant 15, a biologist, said, "I think a lot of it is learned by doing it and you can learn a lot by experience." Although, Participant 15 acknowledged that sometimes this is not always the easiest or quickest way to learn. Participant 6, an engineer, stated, "Throughout my career, I've had a lot of interactions with a lot of people who deal with communication and outreach, and I have certainly gotten some coaching from them."

Participant 15 further explained the need for hands-on experience, "You can't learn to be a good baseball player by reading a book about playing." Water experts had a robust educational background in the various fields of science. Many participants have completed graduate and doctoral programs in their field; however, few have participated in communication training. Participant 7, a wastewater specialist, explained, "Communications is something that you don't get a lot of technical training in. I have a bunch of training in project management, but communication is trickier."

As many participants stated they are inexperienced in communication efforts, they mentioned frustrations that come with unsuccessful communication tactics. Participant 4, a biologist, stated, “You can spend a lot of money advertising and not be very effective with getting the word out.” Beyond limited returns on investment, participants described challenges translating complex, technical research into accessible language for diverse audiences. Some noted difficulty simplifying without “talking down,” while others struggled to balance detail and clarity. Communicating effectively across producers, policymakers, and youth was another common frustration, along with uncertainty about whether messages truly reached or influenced their audiences.

Although participants had limited experience with communication efforts, they shared several tactics frequently used, including the need to include subject matter experts in their communication efforts. Some participants called on staff members with different educational backgrounds and experience. Participant 19, a state conservation official, said, “In a public meeting, we try to always have a subject matter expert available to speak about the science.” Participant 18, engineering academic administrator, agreed, “I think you need different experts in the room when you start to think about communicating because people come at it from different angles.” In addition to subject matter experts, participants utilized communications staff members to enhance their efforts. Participant 6 stated they hope to increase their connection with communication staff, “We hope to involve more communications staff in more of our day-to-day operations.”

Water experts paired communication experts with various tactics to communicate effectively. In addition to general outreach efforts, participants described using presentations, public meetings, social media, printed materials, videos, and direct engagement with stakeholders as part of their communication toolkit. Participant 4 stated “As far as communication tactics, we've tried to do as many different things as possible,” and participants identified successful tactics they have executed in their efforts, such as using online media. Participant 2, a federal water science administrator, shared, “The web has really helped us out with that because it's a great way to get information out there and let people access it.” Visual communication also played a central role across participants’ strategies, including infographics, models, and simulations that help simplify technical concepts. Due to the complexity of the topics, participants tried to include visuals to keep their audience’s attention. Participant 14, a state water supply program manager, stated, “We use a lot of graphic creation to try to put things in a visual way. I think that's the most effective way to explain how systems operate.”

Participants described the need to cater to many differing audiences as water stakeholders are diverse. One strategy utilized by participants is understanding the audience they are targeting. Participant 6 said, “When we interact with them, we try to kind of meet them where they're at to some degree." Experts aim to adapt their communication for diverse audiences, as not everyone has a background in water science or an understanding of these complex topics. Several participants emphasized the need to tailor messages to specific groups, which often involves removing jargon and using plain language. Participant 11, a water project manager, noted the challenge of explaining research, “Every field has vocabulary or vernacular that's a big part of your role.” Participants stressed the importance of catering messages without reducing the meaning or offending the target audience. Participant 15 stated, “You have to change the level in which you're speaking to fit the audience to what you're speaking so that they don't feel like you're talking down to them because nobody likes that.”

Many science fields require vigorous education to gain an in-depth understanding of their field. Some participants stated this can make it difficult to communicate to a general audience. Participant 16, an engineer, explained:

> I went to school for six years learning [stormwater/sewer systems]. I've been doing it for 12 years, and I'm still learning. And then I'm supposed to talk to people that have no previous knowledge of it and have little understanding.

Many participants find it challenging to communicate with the public due to their level of expertise. Participant 11 explained, “I think we struggle because you're typically trying to convey a technical, nuanced topic.” They also face the challenge of balancing how much information to share. Participant 21, a groundwater management administrator, described a thin line between under- and overcommunicating, "I think one communication challenge is sort of the difference between giving too much information and not enough. You can lose people in the details, in the weeds fast.”

RQ2: How do Water Experts Engage with Communities to Foster Collaboration and Shared Understanding of Water Science?

Water scientists communicate with diverse audiences.

Many participants expressed that the water science discipline has many broad, diverse audiences. Participants described that the key stakeholders value different information. Participant 17, a groundwater management director, said, “Everybody is a water user so, everybody is a stakeholder in some way, shape, or form.” Participants emphasize the importance of addressing the needs of water users and stakeholders in the field. Participant 18 stated, "That is probably the most important thing, is being able to communicate with both the professional side, like my colleagues in engineering, and with other stakeholders.”

Working with such a diverse audience presents a challenge when connecting with different stakeholders. Participant 4 explained:

> It's tough trying to communicate to different audiences because you're trying to provide for all. I don't know if that's possible when it's that diverse of users in the area, but we try to cater to those different groups.

This mindset fosters collaboration and ensures that diverse perspectives are integrated in water management strategies. Experts shared that building connections with fellow water science professionals and working together is a valuable approach for addressing complex challenges in the field. As Participant 15 noted, “It would be impossible to get anything done if we didn't all work together, because we are multi-faceted.”

The water science industry is interdisciplinary and encourages collaboration.

Many participants shared that the water science industry is multifaceted and encourages experts to work together. Participant 2 noted, “We collaborate on almost everything we do,” while Participant 15 added, “Science is collaborative and take a village.”

Participants shared that working together across disciplines and with fellow subject matter experts can help science be successful. "I have things that I'm familiar with in my expertise, but when you add somebody else's expertise, we have doubled our knowledge. Science works best when it's collaborative,” said Participant 15.

By utilizing each organization’s strengths and resources, experts can achieve greater impact and promote sustainable water management practices. Participant 11 noted:

> We have a fairly collaborative mindset among the agencies when it comes to water. We work together frequently, and there is a consistent effort to include the other agencies and understand where they are experts compared to where we are.

Participants consolidate their research teams by joining forces, creating a collaborative environment that enables subject matter experts to work closely together. Participant 20, university research administrator, noted the importance of sharing resources stated, “We use research groups to pull together our resources and expertise. It has worked really well and allows the subject matter experts to all work together side by side.”

Additionally, a collaborative science approach allows experts to learn from one another. These coordinated efforts build interdisciplinary connections. Participant 11 said, “It often comes down to knowing who to talk to more than more so than knowing how to do it yourself.”

This highlights the value of networking and communication to advance knowledge within scientific communities. Beyond collaborating with one another, participants noted they frequently consult other agencies for advice and support. Many experts utilized various resources, such as government organizations, educational institutions, and professional network connections. These connections play a vital role in advancing scientific efforts.

Discussion and Conclusions

This study explored the experiences of Kansas water experts in communicating with public audiences, collaborating on research teams, and addressing water challenges and solutions. Participants were highly educated professionals from diverse disciplines and regions across Kansas offering a comprehensive perspective on the state’s water issues. They also represented a wide range of organizational contexts—including universities, Extension, state and federal agencies, groundwater management districts, and other water-related entities—providing insight into how communication practices and collaboration needs vary across institutional settings. Three themes emerged: water experts develop communication skills through experience and peer support, adapt their messages for audiences, and work within an interdisciplinary environment that encourages collaboration. These findings align with existing literature emphasizing that effective water communication relies on simplifying complex information and tailoring messages to meet audience needs (Burns et al., 2003; Martin & MacDonald, 2020), as well as broader science-communication principles such as framing, values-based engagement, and narrative techniques discussed in the literature review (Corner et al., 2018; Dahlstrom, 2014).

Despite limited formal communication training, water scientists employed various tactics to effectively convey complex concepts to a diverse audience. Participants emphasized the importance of visual aids, noting they increased their audience's attention. These experts often explained complex topics and visuals play a role in simplifying complex scientific topics (Burns et al., 2003). They also recognized the potential of utilizing diverse platforms to expand the reach and effectiveness of their science communication but lacked knowledge of each platform’s unique strengths. This training gap echoes prior research identifying the need for scientists to understand medium-specific communication strategies and framing approaches (Corner et al., 2018; Martin & MacDonald, 2020). These findings reflect the Theory of Planned Behavior, as participants demonstrated intentions to communicate effectively but were constrained by limited training, in turn affecting their perceived behavioral control.

The diversity of water science audiences presented challenges for tailored messaging (Burns et al., 2003). As many participants noted, water impacts everyone, which broadened the target audience but complicated efforts to connect with stakeholders who had differing needs and priorities. This aligns with the Social Cognitive theory as experts often observed and adopted strategies from peers when attempting to engage with audiences. The dialogue and participatory science communication models also offer insight, as participants valued two-way engagement but lacked adequate resources.

The interdisciplinary nature of water science promotes collaboration, with many participants sharing experiences working together, creating opportunities for more accurate and clear messaging (Gilbert & Stocklmayer, 2012). Collaboration enhances public understanding and improves communication across organizations with shared goals (Fischhoff, 2013). These findings align with Social Cognitive Theory, as participants built self-efficacy and confidence by observing and learning from colleagues. Conference and workshop organizers in the water and natural resource fields could enhance the value of their events by incorporating structured opportunities for collaborative work. Dedicated sessions for small-group work or peer learning encourage interdisciplinary interaction and provide a space for scientists to refine their communication approaches in real time.

This study highlights opportunities to enhance water experts' communication efforts by emphasizing message tailoring and collaborative approaches. Providing communication training can improve clarity and make scientific expertise more accessible to the public (Fischhoff, 2013). Based on these findings, we recommend that organizations jointly develop training programs that equip experts with tools to engage diverse audiences and build effective partnerships. Extension professionals should consider making trainings opportunities in science communication more visible and accessible to practitioners across the water industry. Several participants indicated uncertainty about what resources were available or how to access them. Specialists could improve awareness by curating and promoting a centralized list of trainings, workshops, and online modules.

An additional but underdeveloped observation concerned participants’ personal relationship with water. Some participants reflected on how water is deeply intertwined with daily life and connected to everyone. This finding suggests an area of interest that could warrant further investigation, emphasizing the need for future research exploring individuals' perceptions of their relationship with water.

The findings of this study are not generalizable due to the limited sample size. Future research should include larger and more diverse samples to better represent the Kansas water community. Expanding the scope to other regions could also reveal whether communication strategies and collaboration patterns are consistent or context specific. Finally, future work should further investigate how experts’ perceptions of water issues influence their communication priorities and strategies, which could deepen understanding of how conceptual frameworks like TPB, SCT, and science communication models interact in practice.

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