Using Body Mapping to Assess Doctoral Students' Preparedness to Serve as Science Communicators

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Abstract

Land Grant Universities (LGUs) are pivotal in equipping the future agricultural workforce with the skills to effectively communicate agricultural and environmental science. This study utilized body mapping to assess graduate students' readiness to become science communicators following a science communication theories course. Initially, doctoral students viewed communication merely as a tool, showing a need for more awareness about its significance in science. Deliberate efforts were exerted throughout the course to foster a classroom environment that empowered students as science communicators. By the end of the course, students had not only grasped the difference between 'communication' and 'communications' but also expressed a keen interest in tackling science communication-related issues. The evolution of communication technologies significantly influences public access to scientific information and the acceptance of science and related policies. Challenges such as these, augmented by urgent concerns like climate change and the Coronavirus pandemic, underscore the need for agricultural and environmental science graduates adept at communicating science upon entering the workforce. However, achieving this level of preparedness requires not only the provision of relevant courses but also innovative assessment methods that foster metacognitive and soft skills, thereby facilitating social, academic, and political empowerment.

Introduction

Communication is a complex process that involves the exchange of meanings, information, and messages among individuals, whereas communications refer to the array of tools and technologies to facilitate this exchange (Alder et al., 2016). In most cases there is increased focus on communications as opposed to communication. Such perceptions stem from the deficit model of communication which emphasizes the need for increased dissemination about scientific issues to shift public opinion towards a scientific consensus (Hart & Nisbet, 2012, p. 701). The deficit model primarily sees science communication as a tool for educating the public about scientific topics, often overlooking the essential element of encouraging dialogue (Trench & Miller, 2012). The rapid evolution of communication technologies and the rise of social media platforms have led to a significant increase in the spread of information (Masambuka et al., 2018).

Although science communication aims to educate and inform, it should equally promote open and meaningful interactions between scientists, experts, and the public. The emergence of agricultural communication as a distinct branch of communication is evidence of the need to share practical agricultural and domestic innovations with rural communities (Tucker et al., 2003). Over time, agricultural communication has seen considerable changes (Cannon et al., 2016). The focus has shifted from traditional print and broadcast news to science journalism and now includes communications related to advocacy and public relations, moving beyond mere technology transfer (Bonnen, 1986; Irani & Doerfert, 2013). In the United States, despite these changes, programs in this field are still widely known as agricultural communications programs (Akers & Akers, 2000; Cannon et al., 2016; Doerfert & Miller, 2006; Kurtzo et al., 2016; Miller et al., 2015; Telg & Irani, 2011; Tucker et al., 2003). These programs mainly focus on equipping

students with technical communication skills, such as writing and graphic design, at the undergraduate level (Cannon et al., 2016).

The emerging challenges of the 21st Century, including the Coronavirus pandemic and the expanding array of information sources, underscore the necessity for educational courses to approach communication as a scientific discipline, not merely as a tool for public education. To adapt to these swiftly changing conditions, it is imperative that postsecondary and agricultural communication programs sufficiently prepare graduates for the evolving job market (Doerfert & Miller, 2006). This perspective is supported by the notion that higher education, particularly at land-grant universities (LGUs), should not only facilitate students' ability to connect academic knowledge with the practical world but also foster critical thinking about the influence of existing societal structures (Roth & Desaultels, 2002; Schultz, 2008). Active learning and project-based activities are recommended as effective strategies to develop essential 21st-century skills (Gavazi, 2020). However, it is crucial to distinguish that increasing student engagement in the educational process does not automatically equate to empowerment, a concept that often needs to be understood (Dimick, 2012).

The body mapping technique is a valuable method for enhancing educational experiences. It explores individuals' perceptions of control and power within specific contexts (Martinez, 2017), making participants more conscious of their embodied experiences and uncovering otherwise inaccessible insights (de-Jager, 2016). As a qualitative research tool, body mapping facilitates the collection of personal stories, offering insights into individuals' identities (Coetzee et al., 2017) and providing scientists with a novel, visually and sensory-rich research methodology (Ball & Gilligan, 2010). Thus, body mapping is an effective way for students to evaluate their learning, expanding assessment perspectives beyond the teacher's perspective to include the students' viewpoints.

Traditional course content selection and assessment methods have been criticized for their top-down approach, as they tend to overlook student perspectives in the educational process. Huba and Freed (2000) highlight that instructors typically maintain complete control over educational content, limiting student input opportunities. Recent scholarly debates advocate for outcome-driven learning, emphasizing the enhancement of metacognitive and soft skills, such as communication, now sought after by employers for well-rounded graduates (Mitsea et al., 2021). These skills are vital for engaging in various domains, including personal, academic, and professional arenas (Mitsea et al., 2021).

While research activities at LGUs are crucial for addressing societal issues, concerns arise that de-emphasizing teaching and community engagement may affect the quality of education and reduce graduates' employability (Gavazi, 2020). A notable concern is the need for more preparation of graduates for science communication careers, despite LGUs' focus on training in this area. Incorporating student-led assessments, such as body mapping, has been scientifically validated to bridge this gap. This approach respects teacher authority while empowering students to evaluate their learning experiences (Biesta et al., 2015). As Fielding (1996) described, empowerment involves transferring some authority from those in power to those with less. Granting students, the agency to evaluate their learning can significantly enhance their knowledge and self-efficacy in communicating scientific or agricultural innovations in response to market demands (see Bandura, 1997). According to Bandura (1997), self-efficacy is a

powerful motivator for action, fostering a sense of conviction and confidence in individuals' abilities to complete assigned tasks.

In summary, body mapping in science communication teaching enriches the learning assessment spectrum, enhancing the quality of education by incorporating student perspectives. Research indicates that active learning strategies can significantly improve critical thinking, self-efficacy, and preparedness for science communication careers, equipping graduates to navigate complex challenges (Clem, 2013).

Purpose and Objectives

The purpose of this study was to use a body mapping strategy to assess graduate students' perceived level of preparedness to serve as science communicators after taking an agricultural communications theories class.

The study used two research objectives to address the purpose:

1. To describe participants' visualization of their knowledge and experiences of science communication before and after taking an agricultural communications theory class.
2. To describe participants' science communication knowledge and experience before and after taking the class.

Methods

The study utilized a qualitative research approach to collect data through mapping data. "Body mapping draws from the tenet that 'mind influences the body based on how socio-cultural context influences the mind,' and acknowledges that by identifying how and where perception is experienced in the body, one can collect information beyond what traditional face-to-face interviewing offers" (Martinez, 2017, p. 2). This methodology effectively captures participants' perspectives (Coetzee et al., 2017). In this study, participants used body mapping to articulate their understanding and interpretation of a communications theory class (Duby et al., 2016).

The research focused on first-year doctoral students enrolled in an agricultural communication theory class at the University of Georgia's Department of Agricultural Leadership, Education, and Communication. The study used purposive sampling to recruit participants, seven students (three males and four females) were involved in the study. All participants were doctoral candidates in the Department of Agricultural Leadership, Education, and Communication, with two students majoring in agricultural communication, two in agricultural leadership, and three in agricultural education. However, three students also served as agricultural extension educators during the time that they enrolled in the course.

Course Content and Administration

The course was delivered synchronously in Fall of 2020, both in-person and online via Zoom. Due to the COVID-19 pandemic, students opted to take the class online or in person. Three students attended in-person, while the rest did so online. To curb the spread of the virus, the

university further mandated all classes to go online after the Thanksgiving holiday. As a result, the remainder of the course occurred online.

The course material covered communication theory, agricultural communication history, crisis, and risk communication, the importance of agricultural and science communication, and current issues in agriculture and science communication concerning communication theories. The class design was to be a discussion-based setting. During the first few days of class, the instructor requested students to participate in the discussions about the readings using shared reflection papers. Students were to critically analyze each class's readings and present summaries to the rest of the class to help guide the discussions. However, during the first three weeks of class, students expressed their concerns via an anonymous questionnaire distributed as part of the feedback collection process. The student expressed difficulty understanding the material because most of them had never taken a communication theory course before, and they requested additional lectures. The instructor incorporated lectures into each class in response to students' needs. In addition to lectures, students utilized case studies and mind maps to increase their engagement.

Data Collection

Data collection occurred during the last week of class. The instructor first requested participants to draw two body maps in response to prompts. Participants started by drawing a body map that represented their knowledge level about science communication, awareness of science communication issues and challenges, and their role as communicators before taking the class. On the second body map, they drew body maps based on the previous prompts with an additional prompt on preparedness to serve as a science communicator after taking the class. Participants also indicated notes on the body maps based on the prompts. Since the class was online, the students could use any technology of their choice to draw the body maps and submit them to the instructor. Since the topic for this study was not sensitive, body mapping activity ensured participants could express themselves freely without following a standard template. Participants were entirely in control of drawing their images based on their understanding.

Data Analysis

A content analysis of the body maps and their associated descriptions was conducted. In addition, content analysis of participants' reflections and researchers' observation notes made it possible to clearly describe the participants' stories (Gastaldo et al., 2018) and triangulate the data (Lincoln & Guba, 1985). Due to the absence of a standardized data coding and analysis tool for body maps, the researcher used a modified evaluation tool based on the indicators of a standard scientist (see Chambers, 1983). Codes were developed based on body map structure (size, shape, and colors). In addition, codes for all the descriptions of the body maps were developed, which included types of description and issues addressed in line with the prompts, namely: awareness of challenges and issues in science communication, role as a communicator, knowledge, and skills in science communication and knowledge of communication theories. Each researcher coded the data independently based on the codebook.

Once coding was completed, images corresponding to each code were grouped and themes were developed by comparing each code with the descriptions that were provided by the participants' reflection papers. The content analysis of the notes and reflection papers assisted in further

triangulation and ensured the trustworthiness of the results (Lincoln & Guba, 1985; Mikhaeil & Baskerville, 2019).

Subjectivity Statement

A postdoctoral research associate whose research primarily focuses on the use of communication as a science for amplifying voices of marginalized and vulnerable groups served as the lead course instructor. She provided academic oversight and infused the curriculum with innovative pedagogical strategies. These strategies included the introduction of mind and body mapping exercises alongside creating tailored prompts to facilitate these activities. Her approach was underpinned by a conscientious effort to mitigate the influence of her research bias, especially regarding identifying potential gaps in science communication and their implications for data analysis and the literature review. To this end, she undertook a thorough literature review to ensure that the development and application of coding schemes were aligned with established research paradigms.

The team also included a professor specializing in science communication. She shared the instructional responsibilities, bringing to the course a firm belief in the scientific nature of communication and the necessity of grounding scientific inquiry in solid theoretical foundations. Her contributions were instrumental in shaping the course content, and she was the architect behind a pivotal learning activity that generated the images and texts serving as the primary data for the study. Conscious of her bias towards emphasizing the need for improved communication within agricultural and environmental science, she opted out of the initial stages of data coding to safeguard the research's objectivity.

A third key figure was another postdoctoral research associate, who brought a wealth of experience in agricultural education and communication. Her expertise is valuable in articulating and disseminating impactful messages tailored to meet clientele's needs. This bias towards client-centric messaging was intertwined with her dedication to fostering innovative teaching and learning methodologies within agricultural communication curricula. Her overarching goal was to arm prospective agricultural communicators with a blend of theoretical understanding and 21st-century skills essential for navigating the multifaceted challenges of modern agriculture. She recused herself from the coding process to preclude and, thus, any biases that could skew the study's findings.

These diverse perspectives and methodological rigor enhanced the research process, ensuring a credible approach to evaluating the effectiveness of the science communication course in improving the career readiness of the study participants as future agricultural communicators.

Results and Discussion

Participants' Visualization of their Knowledge and Experiences Regarding Science Communication Before and After the Class

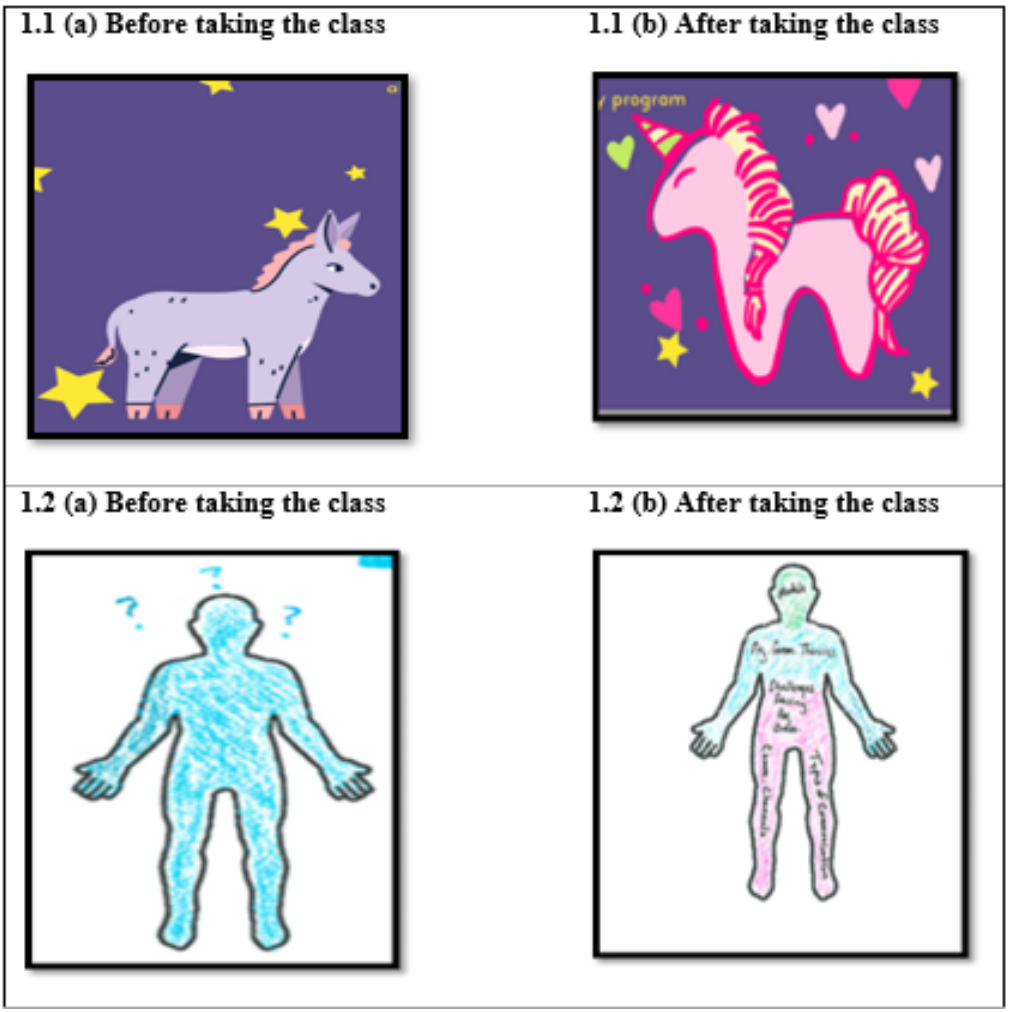
When the students drew body maps presenting their science communication experiences and knowledge in science communication, one theme emerged: *Body maps not restricted to human bodies.* Six participants represented their knowledge and experiences using the actual human

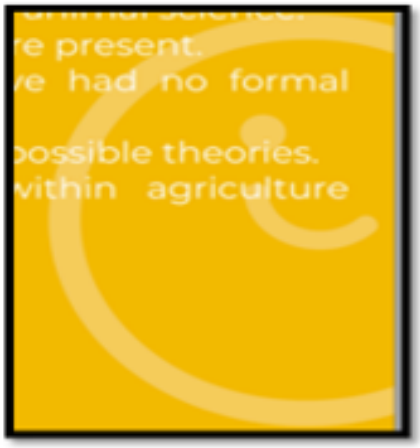
body, while one participant drew an animal to represent his/her knowledge and experiences (See Figure 1).

Figure 1 depicts body maps presentation before and after taking the class. A subtheme, namely: *variation in body map presentation,* emerged when analyzing the images of the participants' presentation of the body maps regardless of whether human or animal. Changes were observed in the colors, size, and features provided between and among participants to reflect the changes before and after taking the class. Different parts of the human were also presented, with four of the students presenting an entire human body form (Figures 1. 2, 1.3, 1.4 and 1.6) while one person presented the head (Figure 1.7 a and b) and another presented the face only (1.5 a and b). In addition, variations in the use of colors were also observed. For example, while the color green represented a positive change in knowledge (Figure 1.4) the same color was used to represent awareness of science communication (Figure 1.3 a and b).

Figure 1

Body Maps Presentation Before and After Taking the Class



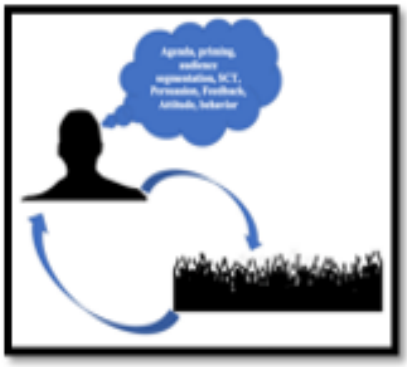
1.3 (a) Before taking the class	1.3 (b) After taking the class
	
1.4 (a) Before taking the class	**1.4 (b) After taking the class**
	
1.5 (a) Before taking the class	**1.5 (b) After taking the class**
	

1.6 (a) Before taking the class

1.6 (b) After taking the class

1.7 (a) Before taking the class

1.7 (b) After taking the class



Participants' Opinions Regarding their Knowledge and Experiences Regarding Science Communication Before and After the Class

Almost all participants had limited knowledge and experience in agricultural communication. Two themes emerged: the *nature of agricultural communication* and *knowledge of agricultural communication and theories.*

Nature of Agricultural Communication

The participants understood communication as delivering agricultural information using different communication channels. As an illustration, one of the participants stated, "My previous thinking was that *Agcom* was about writing articles about important events." The nature of agricultural communication was evidenced in the body maps of two other participants (see Figure 1.7a and 1.7b). The content analysis of the reflection papers also indicated frequent use of the word communications as opposed to communication among all participants.

Knowledge of Agricultural Communication and Associated Theories

Participants indicated they had limited knowledge of agricultural communication and associated theories, as evidenced by the following quotes. "I had no formal knowledge of communication theories." This was echoed by another quote, "My knowledge as a science communicator was very lacking…with no formal knowledge or background. I was unaware of any possible theories." Another participant also raised similar sentiments as evidenced by the following quote: "Mediocre level of knowledge- struggled with specifics of communication." To emphasize the point, the participant explained how the knowledge level was represented in the body map (see Figure 1.4a and b). In addition, another participant also provided a key that explained the colors on the body map, with yellow representing knowledge of communication theories (see Figures 1.4a and 1.4b).

Apart from these sentiments, the participants provided feedback to the instructor to change the administration focus of the class from student discussion of the content to more lectures. The lectures were proposed to ensure the students were taught about agricultural communication and associated communication theories due to limited knowledge.

Awareness of communication challenges and issues

Almost all the participants indicated having limited knowledge of the challenges and issues in agricultural communication, as evidenced by one participant who said, "I was not aware of challenges/issues in science communication." Another participant stated that "I was not super aware of the many issues and challenges that are present." Such sentiments were also vivid in the body map by one of the participants who presented a key where the green color implied awareness of challenges and issues in science communication (see Figure 1.3a and b).

The participants also provided opinions regarding their knowledge and experience in science communication, and the students reported an increase in knowledge of agricultural or science communication. Two themes emerged, namely: *type of change* and *impact of change.*

Type of Change

Three sub-themes emerged regarding the type of changes reported by participants: *knowledge and skills about science communication and communication, perceptions about science communication,* and *role as a science communicator.*

Knowledge and skills in science communication and communication

Most of the students' body maps depicted a general increase in knowledge and skills in communication theories and their applications. (see Figures 1.4a and 1.4b; 1.2a and 1.2b as well as 1.1a and 1.1b). However, one participant reported the changes in knowledge and skills in general. They used different colors to represent each change and provided a key for each color where *orange = knowledge of communication theories; Pink = assumptions about science; Purple = knowledge and skills in science communication; Blue = role as a science communicator, and green awareness of challenges* (Figures 1.3a and 1.3b).

Perceptions about communication

Participants generally indicated developing an understanding of communication as illustrated in the following quote "communication is a HUGE world. It's okay to feel overwhelmed, but I am able to understand and apply the theories." Another participant affirmed prior sentiments saying that, "… communication is an ever-changing and challenging field due to changes in technologies and the world faces more issues." Content analysis of the reflection papers and observation notes also indicated that all the students appreciated the complexity of communication during the class. This was evidenced by a statement made by one of the participants during class which implied that communication is often considered an easy task, however, it is more complicated than it appears. In addition, another participant's reflection indicated a change of perspective regarding the role of science communication from a one-way communication model to a two-way communication model (figure 1.7a and 1.7b).

Preparedness to serve as a science communicator.

Participants' statements indicated they felt empowered and more confident to serve as science communicators after taking the class. One participant said, “I feel more prepared to perform as a science communicator although there are still some things I may be lacking.” Another stated, "I feel more prepared to continue my program after taking this course and to work as a science communicator. I feel confident in my ability to address science communication." Another participant added, "After class, I am confident in carrying conversations about communication methods and purposes. I am also familiar with theories, channels, organizational strategies, and much more."

Conclusion/ Implications/ Recommendations

The qualitative nature of this study limits generalization to a broader audience but vails an opportunity for replication with a broader sample of students or across diverse contexts. The data revealed a discernible trend: Students exhibited an enhanced readiness to take on roles as science communicators post-course completion. Intriguingly, the results unveiled a transformative shift in perception—a transition from viewing communication merely as a tool to a broader understanding of it as communications. This transformation of outlook resonates with the narrative woven by the proliferation of agricultural communication programs across the United States (Akers & Akers, 2000; Cannon et al., 2016; Doerfert & Miller, 2006; Kurtzo et al., 2016; Miller et al., 2015; Telg & Irani, 2011; Tucker et al., 2003), suggesting a reevaluation of the subject matter itself. This raises the question: Is it opportune to reshape the teaching and evaluation of agricultural communication, pivoting it from a mere tool to an assimilation of scientific principles?

A resonant implication surfaces—educators are encouraged to embrace participatory methodologies, as the study's findings underscored. Concepts like concept mapping have previously revealed students' grasp of core ideas and their interconnections (Akinsanya & Williams, 2004). In parallel, body mapping stands out as a dynamic tool for assessing learning and as a catalyst for learning itself. The study underscores the necessity to shift from a predominant focus on technical communication within agricultural communication programs,

particularly at the graduate level (Bray et al., 2012), urging for a broader scope of scientific awareness.

The spotlight extends to the gap in research concerning the effectiveness of graduate-level agricultural communication courses, a void highlighted by this study amidst the predominantly undergraduate program evaluations (Cannon et al., 2014; Clem, 2013; Corder & Irlbeck, 2018; Morgan, 2010). In a rapidly evolving landscape shaped by ICT advancements and the emergence of phenomena like the Coronavirus pandemic, the necessity for comprehensive science communication training transcends mere technical prowess. Nevertheless, the authors recognize that content inclusion alone falls short; the core lies in fostering empowering classroom environments that encompass social, political, and academic dimensions. Empowerment, as a focal point, necessitates instructors to go beyond mere participation assessments, steering students toward multifaceted opportunities for self-directed learning (Dimick, 2012).

Evident in the results is the profound empowerment students experienced—socially, politically, and academically. For instance, instructors introduced early autonomy, granting students the choice of in-person or online attendance, thereby inducing a sense of political empowerment (Dimick, 2012; Oyler & Becker, 1997; Schultz, 2008). This empowerment further materialized through the students' willingness to confront science communication challenges—a testament to Breiting's (2009) findings on political empowerment manifesting through a desire to address societal issues. Simultaneously, hints of social empowerment surfaced through students' input into content delivery (Dimick, 2012). Academically, some students proactively addressed potential hindrances to implementing science communication interventions, revealing their empowerment (Roth & Desaultels, 2002; Schultz, 2008). Students' readiness was not a mere byproduct of course content; instead, it emanated from the power and control they experienced throughout the learning journey.

The findings offer insights into how instructors can cultivate a classroom atmosphere that empowers students, fostering their confidence in applying their knowledge and skills to real-world challenges. Moreover, the research introduces an innovative dimension by pioneering the utilization of body mapping as a tool for capturing sensory experiences. These outcomes align with earlier research (Ball & Gilligan, 2010; Jager et al., 2016), underscoring the significance of visual data collection tools in capturing intricate perceptions that are otherwise elusive. For instance, participants demonstrated shifts in their understanding and abilities by manipulating the forms, colors, and dimensions within their body maps. Remarkably, these body maps unveiled emotions and insights that conventional research methods could not uncover, offering a fresh layer of depth to our understanding. Diversities in the types, styles, and hues employed in these body maps also furnished invaluable insights into how perceptions of different individuals are shaped.

In contrast to studies where participants adhered to pre-designed body map templates (Duby et al., 2016; Naidoo et al., 2020), the present study encouraged participants to sketch body maps based on their comprehension, granting them the autonomy to express their perspectives candidly. While body maps are frequently employed in health inquiries, a lack of standardized evaluation criteria exists, thus highlighting the need for further research to establish consistent methodologies for image analysis. This calls for cross-sectional studies that utilize body mapping to gauge students' preparedness as science communicators at the commencement and

culmination of their graduate journeys. The inherent potential of body mapping in empowering participants to voice their perceptions positions it as a promising technique for probing into students' grasp of knowledge and the broader public's perception of science communication. This genre of research aids in identifying gaps, ensuring that communication institutions equip graduates to disseminate scientific knowledge to the masses effectively. Interestingly, the findings also revealed disparities in individuals' visual representations of their body maps. This prompts a suggestion for future researchers to incorporate interview questions that prompt participants to elaborate on the rationale behind their chosen images, forms, sizes, and hues.

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