Teaching and Learning in Communication Sciences & Disorders

Volume 7 | Issue 2 Article 8

2023

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Recommended Citation

Wood, Carla; Lugo, Victor A.; Garcia-Salas, Miguel; and McCormack, Wayne T. (2023) "A Team Science Training Approach to Enhance Cross-Disciplinary Collaboration in Communication Science and Disorders Programs," *Teaching and Learning in Communication Sciences & Disorders*: Vol. 7: Iss. 2, Article 8.
Available at: https://ir.library.illinoisstate.edu/tlcsd/vol7/iss2/8

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Abstract

This paper aims to describe the core components of a cross-disciplinary team science training offered in a Communication Science and Disorders (CSD) program delivered to 17 doctoral scholars in CSD, education, special education, psychology, and social work. The team science training model is offered as one approach to consider in preparing pre-service leaders and faculty in CSD to engage in scientific collaboration with other researchers from different disciplinary backgrounds. In addition to an overview of training, the paper includes preliminary data on participants' perceptions of team science training and recommendations for future offerings.

Keywords

team science, training, collaboration, doctoral seminar, cross-disciplinary research

Cover Page Footnote

Victor A. Lugo was supported by grant #H325D190011 and Miguel Garcia-Salas was supported by grant #R305B200020, funded by the U.S. Department of Education. The opinions expressed are those of the authors and do not represent views of the Department of Education. Research reported in this publication was supported by the University of Florida Clinical and Translational Science Institute, which is supported in part by the NIH National Center for Advancing Translational Sciences under award number UL1TR001427. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Growing evidence suggests that cross-disciplinary scientific collaborations facilitate impactful and influential outcomes (Jones et al., 2008; Mathieu et al., 2008). To advance science and prepare graduate students to conduct collaborative research and translational science, Communication Science and Disorders (CSD) programs may consider integrating team science training into their doctoral training curricula. By definition, *team science* refers to "scientific collaboration by more than one individual in an interdependent fashion, including research conducted by small teams and larger groups" (National Research Council, 2015, pg. 2). While *team science* may encompass cross-disciplinary (CD) and uni-disciplinary collaborations, interdependent CD team science was the focus of this paper. Like other skills, CD collaboration skills are presumably acquired through instruction and guided practice, yet few graduate programs in CSD include coursework in team science (Wood et al., 2021).

To provide a common understanding of terms, we first define cross-disciplinary teaming and point to distinguishing features compared to other forms of teaming (i.e., unidisciplinary or single disciplinary). In this paper we use the term *team science* to refer to collaboration across multiple disciplines. We use the overarching term "cross-disciplinary" in this study to describe any collaboration across disciplines. Although the team science literature defines important differences among the terms *multidisciplinary*, *interdisciplinary*, and *transdisciplinary*, they are often used interchangeably. The distinctions between terms are related to a continuum of levels of disciplinary integration in a collaboration: *multidisciplinary* research is additive, with lines of research staying within disciplinary boundaries; *interdisciplinary* research involves more interactive or integrated experimental approaches; and *transdisciplinary* research involves a holistic integration of disciplines, often transcending traditional boundaries and sometimes creating new disciplines (Choi & Pak, 2006).

The value of interdisciplinary thinking is well recognized for solving complex educational challenges and to foster innovation (National Academy of Sciences, 2004; Townsend et al., 2015). Moreover, CD collaboration for addressing complex problems has been increasingly adopted in translational research contexts (e.g., Brazile et al., 2018) to address problems too large in scope for one discipline (Mathieu et al., 2008). Similarly, there has been recognition in general education and related services that multifaceted problems may benefit from multiple perspectives and interprofessional collaborations (e.g., Ogletree et al., 2017; Solari et al., 2020; Sylvester et al., 2017). Among these multifaceted problems, is the need for better preparation practices with regard to frameworks for educating students with developmental disabilities in general education settings (e.g., Brownell et al., 2011; Dillon et al., 2021; Patel et al., 2008; Van Laarhoven et al., 2007). Numerous authors in the relevant literature have pointed to the importance and value of CD collaborations for improved outcomes (e.g., Angelini, 2011; Bradley & Monda-Amaya, 2005; Brownell et al., 2011; Cooper et al., 2001; McHatton & Daniel, 2008).

Although educational personnel are expected to collaborate on interprofessional teams towards a common goal in educational contexts (e.g., Dillon et al., 2021; Ludlow, 2012, only a small proportion of faculty in CSD and education report receiving training in team science during their doctoral programs (Wood et al., 2021). In a recent survey of faculty in CSD (Wood et al., 2021), 220 doctoral students, faculty, and research scientists in speech-language pathology and audiology were surveyed about their training in team science and participation in CD research. Results demonstrated low percentages of respondents had received training in collaborative research

(17%) and those with training were more likely to engage in CD collaborative research. In a subsequent study of 980 doctoral students, faculty, and research scientists in education (Lugo et al., under review), only 20% had received training and those who received training engaged in collaborative research more frequently, published more frequently and with larger co-authorship teams, and valued collaboration to a greater extent.

Other previous studies of doctoral training in CSD also point to the need for better alignment between preparation in doctoral programs and the realities of career expectations at institutes of higher learning. Crais and Savage (2020) examined perceptions of 240 doctoral students in doctoral training programs in CSD. The study sought to identify activities that led to high-quality preparation for CSD PhD graduates in research, teaching, and job readiness. Only 55% of respondents indicated that they were very well prepared to conduct research. The authors concluded that some respondents expressed a desire for more experiences across labs, projects, and interdisciplinary efforts.

To our knowledge, there are no previous studies that examine team science training in CSD programs as a means to facilitate cross-disciplinary collaborative research practices; however, research has been conducted in other disciplines with a similar purpose of evaluating models of training at the graduate level to foster teaming skills (e.g., Prichard et al., 2006; Sjolie et al., 2021). Studies generally report positive effects of explicit training on team-based collaboration particularly when reflective learning is included. Prichard and colleagues (2006) reported that students who participated in team-skills training showed higher group functioning than students who did not receive training. Similarly, in Sjolie et al. (2021), the authors reported positive impacts of team-skills training on students' perceived learning of collaboration. One commonality across reviewed teamwork training programs is the emphasis on self-assessment or *reflective practice* as a core component to learning to collaborate (Fathi et al., 2019; Sjolie et al., 2021). *Reflective practice* is defined in the broader literature as "the process of developing new insights through self-awareness and critical reflection upon experiences both in the moment and from past experiences" (Freshwater et al., 2008, p. 1). Although there are few studies that include CSD programs, studies in healthcare offer evidence for a "bundled" multi-component approach to team-training that includes didactic instruction, discussion, active practice, and reflections resulting in knowledge acquisition, improved team processes, and positive impacts on clinical translational practice (e.g., Weaver et al., 2014).

Theoretical Framework

The design of team science training with integrated discussion and reflective learning, is built on the social interdependence theory which provides a foundation for collaborative learning (Johnson & Johnson, 2009). Applying this theory, it is presumed that group discussions and social interactions that include reflections on teaming experiences are associated with increases in students' self-awareness of collaborative skills leading to better outcomes in teaming. Additional foundational support for the pedagogy combining didactic instruction with reflective practice is evident in the broader literature on reflective learning (e.g., Johnson, 2013).

Research Aims

In response to the need for better alignment between doctoral training and expected research practices as future faculty in higher education, the current paper aimed to describe a model for implementing team science training in CSD graduate programs and describe participants' perceptions, reflections, and suggestions for future offerings. We describe components of training, examples of assignments, and reflections on the experiences of doctoral students who participated in the training. The following information is presented as a team science training model to prepare pre-service leaders and faculty in CSD, education, teacher preparation, and related service personnel to engage in scientific collaboration with researchers from different disciplinary backgrounds. The current study aims to address the following questions:

1. What are doctoral students' perceptions of team science training in terms of utility, importance, and effectiveness?
2. What are doctoral students' recommendations for future team science trainings in CSD?

Methods

The overarching project aimed to implement team science training to prepare doctoral students for cross-disciplinary collaboration. This study aimed to describe one training approach and to examine doctoral students' perceptions of utility, benefits, and recommendations for future trainings.

The initial content for course development was based on a "Team Science" course developed as part of the Clinical and Translational Science training program at a partnering university (McCormack & Levites Strekalova, 2021). An initial pilot of a graduate course was offered through Communication Science and Disorders in 2020 based on the existing model. The modules and assignments underwent additional iterative development for a year, leading up to the course offering in 2022 used for the current study. The overall content and expected learning outcomes are largely based on the "science of team science" peer-reviewed literature and open-source resources such as the National Institutes of Health collaboration and team science "field guide" (Bennett et al., 2018) and the National Academies consensus study report on team science (National Research Council, 2015).

Participants. The team science course included 17 doctoral students who were full-time students from different but related disciplinary backgrounds including CSD, education, special education, psychology, and social work. All students were invited to participate in the current study by email invitation using Qualtrics (https://www.qualtrics.com). Of the 17 students, 8 agreed to participate in the current study. The class was comprised of 16 females and one male who all spoke English as their primary language. Students ranged from second year to fourth year doctoral students. Based on responses to six demographic questions on a survey, participants described their backgrounds. Of the 8 respondents who agreed to provide further information, 62.5% reported being White, 37.5% Black, and 12.5% identified as Hispanic/Latine. Two respondents were first generation scholars. The majority of doctoral scholars were from Florida with others hailing from Mississippi and California. No student reported receiving prior coursework or training in team science.

Procedures.

Course Components. Students had access to an online learning management system in which each of the core topic areas were set up as modules with stated learning outcomes and supplemental readings. Students engaged with the online modules independently and were self-guided in their review of the online modules. Students then participated in weekly synchronous discussions and lectures. Core topic areas included:

- introduction to the science of teaming
- preparing for teaming
- assembling teams
- team leadership
- developing a collaboration plan
- writing authorship agreements
- managing teams
- fostering psychological safety

Asynchronous Instructional Modules. The course included modules related to fundamental aspects of teaming and collaborative research. On average, participants spent 24.2 hours in the Learning Management System, with a range of 7.5-143.9 hours. Specific modules, described in detail below, included: the science of teaming, preparing for teaming, assembling teams, developing collaboration plans, writing authorship agreements, managing teams, sharing data, team leadership, and fostering psychological safety.

Introduction to the Science of Teaming. The first instructional module was designed to provide an overview of the science of teaming as well as foster an appreciation for teaming and its importance in science. The module included basic principles, challenges of teaming, and evidence of effectiveness. Stated learning objectives included: (a) explaining how team science is more than collaboration; (b) differentiating between multidisciplinary, interdisciplinary, and transdisciplinary research; (c) recognizing challenges to team science; (d) reviewing evidence for the impact of team science; and (e) identifying how to access resources and supports for team science. Students were first asked to read the first chapter of the *Field Guide to Collaboration and Team Science* (Bennett et al., 2018) and the first chapter of *Enhancing the Effectiveness of Team Science* (National Research Council, 2015). Supplemental readings were also provided (e.g., Wood et al., 2021; Wuchty et al., 2007).

Preparing for Teaming. The module on preparing for team science was designed to challenge participants to consider their readiness for collaborating on CD research teams. Participants were encouraged to identify desired skills for team membership and leadership, self-assess readiness for membership and leadership on research teams, identify different leadership styles and situational leadership, and draft a vision statement for their personal research group. Students were then assigned to read the second chapter of the *Field Guide to Collaboration and Team Science* (Bennett et al., 2018).

Assembling Teams. The module on team assembly provided an overview of types of teams, considerations for selecting potential team members, essential roles in translational science teams (e.g., big picture thinker, skilled communicator, methods maven, domain scholar, expert implementer, silo bridger, multimodal disseminator; Petscher et al., 2020). During synchronous sessions, the students discussed factors that influence team performance. Students then read and discussed the assigned reading for the module (Petscher et al., 2020). Supplemental readings to support discussion on the science of building teams were provided (e.g., Pentland, 2012).

Team Leadership. The team leadership module emphasized characteristics of exemplary leadership practices. The module materials provided an overview of different leadership styles and discussion focused on considerations of different leadership styles. Among key practices, the module highlighted leadership techniques from *The Leadership Challenge* (Kouzes & Posner, 2018), including tools for creating a shared vision, challenging the process, enabling others to act, and encouraging the heart of teammates. Additional resources on specific leadership styles, such as servant leadership (e.g., Greenleaf, 1970), were shared.

Collaboration Plans and Author Agreements. The module on collaboration plans systematically reviewed and discussed ten components of collaboration plans as outlined in the course readings (e.g., Hall et al., 2019). These included: (a) a statement of the rationale for the team approach and team configuration; (b) assessment of collaboration readiness; (c) technological readiness; (d) team functioning; (e) communication and coordination; (f) leadership, management, and administration; (g) conflict prevention and management; (h) training; (i) quality improvement activities; and (j) budget and resource allocation. Among resources in the module were examples of authorship agreements. These provided an overview of ethical standards for authorship and an array of contributor roles (e.g., conceptualization, data curation, analysis, investigation, methodology, visualization, writing, review and editing). Discussion also focused on the roles and responsibilities of authorship relating to the order of authorship and distribution of tasks across the core-writing team.

Managing Teams. Within the course module, data and team management were core topics along with additional discussion of common teamwork processes including communication, coordination, and conflict management (Marks et al., 2001). Resources on data carpentry and cross-institution sharing of data were considered important to data management on CD teams. Additional management considerations were discussed, such as establishing rules for variable naming to identify concepts, times, and types of the variables. Other important considerations for data agreements included plans for cross-site collaborations, handling missing data, procedures for double entry reliability calculations, how to handle conflicting data, and the creation of code books and data dictionaries to aid cross-site project coordination and management.

Fostering Psychological Safety. The course concluded with a section dedicated to psychological safety and fostering safe collaborative environments. Based on models of team behavior (Edmondson, 1999), psychological safety and its influences on team performance, participation, and interactions among team members were discussed. Students learned that the likelihood of team members' participation is influenced by their knowledge of permissible versus unacceptable team behaviors, leadership expectations (Higgins et al. 2022), and perceived risks of being punished or viewed as incompetent (Edmondson, 2002). The goal of psychological safety is not to simply make people feel safe to make mistakes or speak up but to mitigate learning anxiety so that positive change can occur (Schein, 1996). Scholarly works (e.g., Bennett & Gadlin, 2012; O'Donovan & McAuliffe, 2020) were assigned in this module and students were provided time to reflect on and discuss their experiences serving on psychologically safe and unsafe teams. Finally, resources for improving psychological safety (e.g., Edmondson, 2014; Thompson, 2009) were shared.

Synchronous Lectures. In addition to asynchronous instructional modules, scholars participated in weekly synchronous discussions and lectures using the Zoom video conferencing platform. The synchronous sessions included brief overviews of core topics covered in the online modules and small group activities to foster discussion and exchange constructive feedback on draft assignments. Throughout the course, there was discussion on influencing factors that promote and hinder the effectiveness of small group and large-scale CD collaborative research and training.

Learning Outcomes. Learning outcomes were identified based on team science courses offered in other disciplines (e.g., biomedical sciences) at other colleges and universities. Specific learning outcomes were created so that, upon completion of the course, students would be able to:

- explain the rationale and methods to improve how scientists interact and integrate across disciplinary, professional, and institutional boundaries
- differentiate between multidisciplinary, interdisciplinary, and transdisciplinary research
- identify factors to consider when joining/forming a research team
- devise a research team vision and mission statement
- identify factors that promote and inhibit the success and productivity of scientific teams
- explain group decision-making techniques
- construct an authorship agreement to plan for and manage credit and sharing
- explain the mechanisms available to resolve conflict
- contrast effective and ineffective practices in team science
- identify leadership dimensions, expectations, and challenges in research teams
- formulate a collaboration plan to foster effective collaborative research
- propose ways to foster trust among team members
- propose strategies to sustain and strengthen research teams
- evaluate strategies for team evaluation, monitoring, and self-correction
- identify funding opportunities that support team science initiatives
- appraise the policies and procedures of institutions and research funding agencies that act as barriers or facilitators to team science.

Assessment of Learning Outcomes. Assignments designed for the course served two purposes: to assess students' learning outcomes and to foster opportunities for students to reflect and apply the instructional content discussed in lectures. Students were encouraged to engage in experiential learning through a combination of projects, several of which entailed collaborative components. Readings, class reflections, and team-based projects were designed to build knowledge and skills for effective team science. Reflection questions were designed to assess students' learning outcomes by incorporating questions related to the stated outcomes (e.g., explain rationale, propose ways to foster trust, propose strategies to sustain and strengthen teams, appraise the policies and procedures of institutions). Through the following assignments (see Table 1), students were challenged to examine the processes by which scientific teams organize, communicate, and conduct research. Core assignments are described in detail below and included: (a) writing and presenting an elevator pitch; (b) drafting and refining a mission/vision statement and giving constructive peer feedback on the statements; (c) review of a scholarly article related to team science; (d) writing a collaboration plan with an authorship agreement; and finally, (e) constructing a collaborative research proposal. The course culminated in a fully developed research proposal involving researchers from two or more disciplines.

Table 1

Description of Assignments

Title	Description
Elevator Pitch	With an interdisciplinary audience in mind, prepare a 3-minute or less elevator pitch. The pitch should introduce and describe yourself for consideration as a potential research collaborator (e.g., training/background, research focus, interests and future directions).
Mission and Vision Statement	Construct a team vision and mission statement specifying the kind of research you want to do (i.e., team goals), why the research is important to you (i.e., motivation), and the kind of team atmosphere you prefer (i.e., research culture). Refinements will be supported by an iterative development process. The final product will be a concise 2-3 sentence statement about your overall goal(s), what motivates your team, and what kind of research culture your team will have.
Scholarly Review Article	Select one article related to team science and/or collaborative research for review. Feel free to use the articles listed and linked under the resources module or locate and select an article from external resources (e.g., library search, google scholar, etc.). Headings you might consider include citation, brief overview, strengths and weaknesses, key take-aways/conclusions, and next steps and future research.
Collaboration Plan with Author Agreement	You will draft a collaborative plan to consider challenges and how to address them during collaborative research activities. Development and refinement of the draft plan can employ an iterative development process with feedback provided on plan prior to submission, if desired. Among required components, the plan will consider: a) why your scientific questions or goals require a team approach; b) your collaborative assets and readiness; c) shared goals; d) strategies to support team function; e) a plan for communication and coordination of daily operations, task allocation, resource sharing, and credit/authorship; d) a plan for leadership and management; e) anticipated conflict and management; and f) training needed to support cross-disciplinary work with attention to content and format.
Collaborative Research Proposal	Consider your potential topic for your dissertation. Is there one additional question you could ask that could be better addressed through collaboration with a partner outside your discipline? Propose a research plan around a research area you are considering that includes this additional question (to be answered with a cross-disciplinary approach). Your final integrated research plan will comprise the final paper and a short presentation on the research plan. The first part of the report consists of collaboratively developed products, while the second portion involves individual reflection and action planning.

Survey of Perceptions. The lead author constructed a survey designed in consultation with coauthors to answer the current research questions. After completing the course modules on team science, the survey was administered via Qualtrics to elicit students' perceived knowledge of the utility and effectiveness of team science training for acquiring foundational knowledge and skills, suggestions for future trainings to better prepare scholars to engage in CD collaborative research, and their likeliness to utilize the skills taught in their future research endeavors.

Data Analysis. A mixed-method approach was used to address the research aims. Descriptive data from survey responses was used to quantify the frequency of response types. For items with a scaled response rating (e.g., enjoyment, value of team science training), we aggregated by agreement (strongly agree and somewhat agree) versus disagreement (somewhat disagree and strongly disagree). For open-ended responses on the survey and submitted reflection responses, we employed a conventional qualitative content analysis (Creswell, 1998; Hsieh & Shannon, 2005; Lincoln & Guba, 1985). The first author undertook initial familiarization with the data via immersion in the responses, which was followed by identifying an initial thematic framework based on the question topics. The second author took primary responsibility for triangulating participants' written responses on reflective assignments to enhance rigor. The third author led the analysis of suggestions for future offerings. The investigators utilized an iterative process of content analysis to identify and define codes for response types (Krippendorf, 2012). The initial labeling of main ideas led to clustering the labels by similar topics to derive categories and subcategories. These categories or themes were used to characterize the participants' responses in relation to each other. As each unit was coded, it was compared to other themes to determine if it could stand alone or belonged to an existing category. A constant comparative method was used to determine if a response was similar to another category or warranted a new category. This process continued until all units were grouped into specific categories based on shared topics and ideas. The individual units of responses converged to themes that were agreed upon by the first three authors who engaged in the data analysis.

Results

Students' Perceptions of Utility and Effectiveness. All respondents (8 out of 8) reported that they enjoyed learning about team science and that it was valuable. When asked about how they anticipate using the materials and resources from the course, participants emphasized the utility of authorship agreements and collaboration plans. Among specific written responses, one student wrote, "I will reach out to other practitioners who may inform my research and ask them to collaborate with me." Another noted that she would "use [information from class] to guide how I set up my research team to meet the needs of those in other disciplines and assist us in effective and efficient meetings." One respondent commented on the utility of leadership materials, stating, "I will use this information to help build my own leadership skills, to recognize the expertise in others, and to build teams that serve specific purposes or fill specific needs." Finally, three students formed a new cross-disciplinary research project with other course participants related to their PhD work in hopes of leading to a co-authored paper. As such, one of the team members noted that the course experience was useful to "collaborate with classmates from a different discipline."

Collaboration Plans. All respondents highlighted the utility of collaboration plans. One participant noted:

> "Having a collaboration plan allows a team to partner, strategize and prepare a plan that will hopefully allow the team to proactively prepare. It's intended to be an organized and structured way that allows the team to have a game plan."

Another participant pointed out the usefulness of developing a collaboration plan in terms of deciding if the team composition is a good fit. He wrote, "When expectations and norms are presented before an individual joins a team, they can make a better decision about their fit within the team."

Further, seven respondents commented on the value of the process of developing a collaboration plan with benefits extending beyond the product of the plan. Among aspects of the process that scholars highlighted, one noted: "opportunities to establish shared practices, agreed upon routines and tools of understanding." The value placed on the process is observed in the written comment of one scholar who wrote:

> "I think the act of holding space for discussion, planning, transparency around expectations, and strategically examining potential conflicts is not only valuable for creating open lines of communication but also for creating a boundary for all parties involved."

Also evident in participants' comments regarding collaboration plans, was an emphasis on the relation between collaboration plans and trust-building between team members. One respondent stated, "team members interact and relationships are formed. Trust is not automatic just because everyone signed off on a plan; it is imperative that each team member commits to the execution of the plan and to the well-being of the team." Similarly, another scholar added, "It is essential to anticipate the conflicts that can arise to prepare strategies that can be utilized to assure any concerns team members can have. Preparing strategies prior to conflicts arising can also help to better promote open mindedness and psychological safety." The relation between collaboration plans and psychological safety was also evident in the following statement, "Walking through the conversations needed in order to have a solid collaboration plan allows a team to build that atmosphere of psychological safety and communicate how conflict or other issues will be resolved before they happen."

Diverse Expertise. When asked about benefits and advantages to team science more generally, four commented on the benefits of diverse expertise and collective knowledge. To illustrate, one student wrote, "I think one of the big benefits of team science is that it allows people to showcase and share their areas of expertise." Relatedly, nine respondents noted the advantage of diverse perspectives that team members contribute to collaborations. This is particularly exemplified in the statement of a graduate scholar who wrote:

> "One of the advantages of working in these cross-disciplinary teams is what you learn of those views, perceptions, biases, backgrounds, and histories that come from people and disciplinaries that are different from your own…. allows everyone to learn, stretch, and build new knowledge."

Further, seven respondents commented on the particular benefits provided by collaborating with researchers who have different ways of conducting research or use different methods for analysis. The overall sentiment that team science offers mutual benefits across member of the team can be observed in the statement of one doctoral scholar who wrote:

> "Through the process of allowing ourselves to be vulnerable and open to new learning challenges, my colleagues and I gained knowledge about designing a study in which researchers and practitioners mutually benefitted."

When asked about team assembly, all participants placed importance on diverse compositions of teams. This sentiment is particularly demonstrated by the written reflection of one participant who wrote, “diversity of expertise is extremely important for my (future) translational research teams. It is not only a top priority I plan to have when leading a research team but also is expected among successful teams.” Similarly, another participant reflected on the importance of diversity among team members as illustrated by her comment, “diversity allows for richer research development, promotes appeal to various stakeholders which expands reach, and fosters innovation.” Further, one respondent reflected on her own teaming roles and identified strengths in the role she plays as a “*Silo Bridger*” on teams to build connections and identify intersections between researchers. The importance of diverse expertise among team members is exemplified in the reflection of one of the participants who replied, “I have seen how important having a varied team of knowledgeable experts working together toward a common goal is, and…I plan to implement this type of team building within my future research teams.”

Suggestions for Future Offerings. Participants identified several ways in which the team science training could be further enhanced. First, instruction on engaging the public in team science would be a valuable addition to future courses. Limited instruction focused on key elements to consider when working with families and community stakeholders. Specifically, it was recommended that future offerings incorporate community stakeholders and pivotal elements and examples of public engagement in each of the development, conceptualization, implementation, and translation phases of team science. Related to this suggestion, another respondent suggested engaging the intellectual community of the university by highlighting different research labs on-campus through invited panels in which “members of a lab that incorporates team science discuss the pros and cons and real-life application of team science.” Similarly, another participant recommended that future offerings integrate additional guest speakers.

Another key focus in suggestions to enhance future offerings of team science included an increased emphasis on diversity, equity, inclusion, and accessibility (DEIA) within research teams. Specifically, one respondent recommended that future offerings include “deeper discussions of what aspects of equity are important to discuss in the implementation of team science and how teams have successfully maneuvered equity challenges when they arose.”

Discussion

Key Findings. A consistent takeaway from responses of participating scholars was that respondents valued team science training and reported a high likelihood of use in future research. Among frequently named components of training that had high perceived utility, doctoral scholars identified mission/vision statements, collaboration agreements including communication and conflict management, authorship agreements and consideration of psychological safety.

Value and Utility of Team Science Training. The fact that all participants agreed that learning about team science was valuable contributes to the literature on perceived benefits of team science training. Additionally, the recurrence of notation in students’ reflections that participants gained knowledge that would be useful to them for CD collaborations, further validates the potential positive impact of integrating team science training into graduate training programs. The finding that scholars placed value on core components of the training is consistent with reports in the literature that these teamwork processes are important to laying a strong foundation for team work (e.g., Marks et al., 2001; Mathieu & Rapp, 2009). The additive value of projects and integrated discussions reported by respondents in the current study is also consistent with benefits of hands-on experiences working in teams reported in prior studies in other disciplines (e.g., Wildman & Bedwell, 2013).

Suggestions to Enhance Future Offerings. Respondents' suggestions for future offerings highlight the desire for more community engagement in training that is well aligned with the *participatory team science* paradigm in the existing literature. Applying this paradigm, it is presumed that collaborative approaches that consider the public as active members of teams can build knowledge and solve complex problems that are rooted in their communities (Tebes & Thai, 2018). This suggestion is timely considering the growing number of authors calling for the integration of community stakeholders in research and training in research-practice partnerships, or long-term research collaborations to address community challenges (Farrell et al., 2021; Selker and Wilkins, 2017). For example, Selker & Wilkins (2017) have proposed including stakeholders such as community members and patients in what they call "broadly engaged team science" to generate more impactful research. Farrell and colleagues (2021), acknowledge that greater involvement in research-practice partnerships yields more positive change for stakeholders. Recommendations from participants in the current study support the need to consider innovative approaches to engage community stakeholders in addition to cross-disciplinary faculty in institutes of higher education.

The recommendation for more emphasis on DEIA in team science is also supported by recent studies that suggest team members from traditionally minoritized backgrounds report experiencing lower psychological safety on collaborative research teams (Lugo et al., under review). Despite an increased emphasis on DEIA in many institutions, academia (and subsequently research teams) remain dominated by cisgender, white, heterosexual men (Hattery et al., 2022). The need for increased focus on DEIA in for future team science training programs is substantiated by other authors (e.g., Hattery et al., 2022) who have reported that the lack of diversity has led to members of traditionally minoritized groups being excluded from research teams or left faced with large power imbalances within those teams.

Although further empirical study is needed on effective practices for enhancing DEIA in team science training and practice, Hattery and colleagues (2022) offer practical strategies that use reflexivity and positionality to create diverse, equitable, and inclusive teams. First, team members can acknowledge and understand how their background, assumptions, feelings, and positionality affect the team building process and then share that positionality with their team members. Hattery et al., (2022) offer guidance suggesting that being transparent about one's privileges allows for them to be confronted and subsequently creates an environment where all members of a team feel welcome, centered, and valued. Next, team members should be aware of when marginalized people are being dismissed or ignored, respect their perspectives, and amplify their voices rather than speaking for them. Finally, senior members of research teams should seek opportunities to mentor and sponsor people from marginalized identities. From guidance on their work to professional networking, mentors can engage in cultivating team members to ensure they are ready for professional roles and furthermore break down the exclusive groups of privilege in which that support has typically taken place. These steps are recommended in the literature to ensure that research teams are not just diverse, but are also equitable and inclusive (Hattery et al., 2022).

Limitations. Although the present study provided insight into one approach to providing team science training in doctoral programs, caution must be taken when interpreting the results. The current design, which allowed for report of descriptive findings at a single time point, was a recognized limitation without a pre/post comparison. It would be interesting and presumably beneficial to monitor skill development and self-efficacy over time as skill-level in cross-disciplinary teaming may likely be on a continuum of development over time. Like many other skills, it is reasonable to presume cross-disciplinary collaboration skills may be acquired and require or benefit from experience and practice over time. Given literature suggesting that students benefit from information, demonstration, practice, and feedback over time (e.g., Kraiger, 2003; Wildman & Bedwell, 2013), future studies are needed to consider other multi-component approaches with other training components over time such as cross-training (Marks et al., 2002) and team dimensional training (Smith-Jentsch et al., 2008). Future studies are needed that allow for a longitudinal study across multiple time points to better understand the impact of training.

Although this paper aimed to provide a description of team science instruction and report on participants' experiences and perceptions, no casual claims can be assumed between engaging in the course and the end of semester. Notably, it is possible that doctoral scholars may hold implicit positive impressions of teaming and/or express a high likelihood of engaging in cross-disciplinary collaborative research regardless of participating in training. It is also possible that the scholars who elected not to share feedback had different perceptions. Relatedly, it would be interesting for future studies to examine specific aspects or components of training rather than eliciting feedback on multi-component instruction.

We also acknowledge that the cohort was a small group of students, many of whom had professionally related interests in outcomes of children and youth. It cannot be assumed that other student populations would engage similarly in collaborative team science training alongside speech-language pathology students. Evaluation of doctoral offerings in team science should be replicated in multiple doctoral programs in CSD with students from more diverse disciplinary backgrounds.

Conclusions and Implications. Declarations of the importance of cross-disciplinary teaming in research are undisputed. We suggest that the cultivation of team scientist-practitioners in next generation scholars should include deliberate instruction, practice, discussion and feedback on team science related knowledge and skills. Toward this end, we offer components of one approach for consideration for inclusion in Communication Science and Disorders programs. The model described is only one possible approach and other approaches to integrate team science into doctoral programs warrant further investigation.

Disclosures

The authors have no financial or nonfinancial disclosures to report or conflicts of interest.

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