Rapid Ethnographic Assessment of Workshops on Transdisciplinary Intercultural Competence, Community Engaged Practice, and Mixed Research Methods

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ABSTRACT

This paper is a rapid ethnographic assessment of six workshops on intercultural competence, community-engaged practice, and qualitative data analysis, which were designed for and offered to graduate students in different academic backgrounds. The workshops intend to foster transdisciplinary education that leads to stronger solution-seeking processes in the face of intensifying climate change and efforts to sustain and enhance life on Earth. The workshops are part of a U.S. National Science Foundation-funded project, which was awarded to scientists from anthropology, education, and engineering. Participants in the first cohort included master's and doctoral students from psychology, counseling, sociology, environmental engineering, industrial engineering, mechanical engineering, and sustainable energy engineering. During the workshops, participants enacted a number of dynamic simulations and role plays as future transdisciplinary environmental professionals facing unprecedented challenges. Workshop elements included mapping your cultural orientation, positioning values along a spectrum, theorizing plateaus of adult and organizational development, analyzing interactions, identifying principles of community-engaged practice, completing community engagement plan components, utilizing qualitative research tools including interviewing and coding, and analyzing qualitative data. Interactive practices were used to simulate embracing radical differences and care (e.g., talking stick, consensus-seeking discussions and decision-making, and Johari window). The workshops provided opportunities for participants to engage in ways to understand their own cultural positioning, each other, and diverse ethnolinguistic marginalized communities that often suffer the most from the deleterious effects of climate change. The paper will present the general design and structure of the six workshops and report the results from a rapid ethnographic assessment of the first cohort who completed the workshops. Ongoing participant validation strategies were deployed, which the paper reports from inductive coding and analysis of student class notes, interviews, and workshop planning.

INTRODUCTION

The worldwide picture for our earth and all of us is grim according to the 2023 Report of the Lancet Countdown on Health and Climate Change [1]. The report provides evidence that climate change is resulting in an increase in heat-related death, damage to land, plants, and animals, a rise in life-threatening infectious diseases "such as dengue, malaria, vibriosis, and West Nile virus" [1], peril to water security, sanitation, and food production, harm to livelihoods and economic loss. Preparing the next generation of Environmental Professionals to tackle these and additional challenges is daunting. This paper shares some preliminary reflections on six short workshops to humanize care, commitment, skill, and responsibility for the heavy lifting involved in facing the effects of climate change. The workshops introduce graduate students to the concept and practice of transdisciplinarity, weaving together topics from intercultural competence, community-engaged practice, and qualitative research design as a means to foster stronger solution-seeking processes in solving our pressing climate issues. The workshops are part of a U.S. National Science Foundation-funded project, which was awarded to our transdisciplinary team of scientists from anthropology, education, and engineering.

In this paper, we discuss transdisciplinarity and its application in our project, present the general design and structure of the six workshops, and report the results from a rapid

ethnographic assessment of the performance of the first cohort of graduate students who completed the workshops. We address the following research questions (RQs):

RQ1: How effective is the first iteration of workshops in fostering student learning outcomes in intercultural competence, community-engaged practice, and qualitative data analysis?

RQ2: How did the workshops promote transdisciplinary approaches to climate change solutions?

Future environmental professionals will need a broad understanding of the dynamic relationships across natural, social, and engineering systems. These workshops represent a scalable curriculum that can be offered to graduate students from diverse disciplines as a co-curricular dimension to their degree plans. Through the completion of these workshops, the intent is to help grow students as future environmental professionals who will transcend traditional epistemological boundaries in the search for new ways to organize knowledge that supports sustainable solutions to global problems. If successful in achieving their student learning outcomes, the workshop design and series can be implemented across other institutions to build the next generation of transdisciplinary environmental professionals.

THEORETICAL FRAMEWORK

Transdisciplinarity

Transdisciplinarity [2], [3] is an approach to knowledge, research, and problem-solving that is characterized by transcending disciplinary boundaries; co-constructing research methodologies, including research frameworks, questions, interpretations of findings, and future research directions; and engaging non-academic stakeholders in research and problem-solving processes. The work of transdisciplinarity is distinguished from multidisciplinarity and interdisciplinarity. Multidisciplinarity stresses a separate and distinct stance for different disciplines, with little to no interactional or collaborative entailment across disciplines and little to no redrawing of disciplinary boundaries. If border crossing and blending occur at all, it is usually only at the conclusion of a multidisciplinary project. Interdisciplinarity generally stays within disciplinary frameworks, paradigms, and theories and takes a narrow view of stakeholder involvement when compared with transdisciplinarity. There is considerably more dialogue across disciplines than in multidisciplinarity, but there is usually no attempt to holistically seek a new paradigm beyond the borders of normative disciplinary boundaries. In the words of Karen Barad [4], we best not "fail to appreciate the transdisciplinary networks of knowledge and production making—transcending the divisions between physical, biological, and engineering disciplines—that are being (re)configured at a pace that humanities proponents of transdisciplinarity only dream about" [4].

In transdisciplinarity, researchers and community stakeholders engage in dialogic processes and intensive collaborations. They blend their own subject positioning, diverse perspectives, and knowledge beyond conventional ways of knowing and narrow disciplinary foci toward new solutions. Subject positioning refers to where we locate ourselves – as, for example, in the complex problems that arise from global warming and that resonate with humanity and the earth, its flora and fauna, as well as nonliving matter.

Adopting such a transdisciplinary framework reinforces the wider project of engineering education, because promoting transdisciplinary subject positioning of a multidisciplinary faculty, cohort of students, and community stakeholders, positions stronger solution-seeking to our pressing climate change and sustainability concerns. Yet, it is too easy to only pay lip service to a transdisciplinary transformation, while falling back to our own particular cultural competencies, ethno-relative perspectives, disciplinary knowledge, assumptions about research and application, and community engagement across our lives up to this moment. Through the workshop curriculum focus on role plays and simulations in intercultural competence, community-engagement strategies, and qualitative data analysis, this project endeavors to foster transdisciplinarity and show how the project participants are becoming trustworthy, concerned environmental professionals across our entanglements with each other and the high stakes surrounding global warming for all of us.

Framing the Transdisciplinary Journeys for the Next Generation of Environmental Professionals (EPs)

For our student participants, transdisciplinarity is framed as a journey of 'meaning making' to becoming trustworthy concerned EPs who are entangled in our world and not set apart from it. In the spirit of transdisciplinarity, such a framing is based on Physicist and Feminist Karen Barad's theoretical work [4] at the intersection of science and philosophy. For Barad, "Meaning is not a property of individual words or groups of words but an ongoing performance of the world" [4]. Meaning becomes '*co-constructed*' and '*soft assembled*' through dialogic processes [5], [6] and '*intra-actions*' (as opposed to 'interactions') [4].

The concept of *'intra-action'* is particularly relevant as a conceptual device in transdisciplinarity, because it emphasizes relational spaces and co-creation. As Barad describes, "The neologism 'intra-action' signifies the mutual constitution of entangled agencies. That is, in contrast to the usual 'interaction,' which assumes that there are separate individual agencies that precede their interaction, the notion of intra-action recognizes that distinct agencies do not precede, but rather emerge through, their intra-action" [4]. It is in the spaces of experience and encounter with ideas, one's selves, others, things, and the world with which meaning is co-constructed and soft-assembled. Within this context, our own agency is not "something that someone or something has," but our agency is instead 'doing' or 'being' in this space of intra-activity [4]. In this paper, we will refer to our workshop module activities as 'intra-actions' to emphasize the emergent transdisciplinary spaces and relations they represent. Framing our six transdisciplinary workshops in this way emphasizes that meaning is dynamic, adaptive, and nonlinear across these journeys, and it forefronts the utility of these intra-active spaces for transdisciplinary solution-seeking to pressing issues.

METHODOLOGY

Rapid Ethnographic Assessment

This study utilizes the methodology of a *rapid ethnographic assessment* (REA) to evaluate the extent to which the workshop series focus on intercultural competence, community-

engagement strategies, and qualitative data analysis succeed in fostering transdisciplinary outlooks and skills. REA is a qualitative research framework that "focuses on the collection and analysis of locally relevant data. It is an approach and orientation to data collection that can be used for a variety of purposes; for example, for exploratory or formative research, for program assessment or needs assessment, as a rapid response tool, or for program evaluation." [8] Like long-term ethnographic research design, it includes data that is usually coded and triangulated, as in this study. Aligned with Sangaramoorthy and Kroeger [8], this study is part of our formative assessment of a three-year project and serves as an evaluative framework by which to continue to improve our workshops in culturally sustainable and relevant ways.

Richard Shavelson and Lisa Towne [9] from the Committee on Scientific Principles for Education Research point out that "education is multilayered, constantly shifting,...highly value laden and involves a diverse array of people and political forces that significantly shapes its character. These features require attention to the physical, social, cultural, economic, and historical environment in the research process because these contextual factors often influence results in significant ways. Because the U.S. education system is so heterogeneous and the nature of teaching and learning so complex, attention to context is especially critical for understanding the extent to which theories and findings may generalize to other times, places, and populations" (p. 5). Ethnographic research design grasps the shared cultural practices that emerge from the data and provides strong descriptions of context (e.g., the people, the setting, curriculum, seating arrangements, etc.) [7]. To our thinking, this is a strong endorsement for selecting rapid ethnographic assessment at this early stage of our project. Three years from now we will, perhaps see the theories and findings generalize, particularly across community engagement beyond our workshop settings.

In addition to addressing the need to inform faculty on how to improve workshop design, REA design in this project may lead us to ways to improve how we address the needs of students who will participate in community-engaged or service-learning activities after the six workshops. These students will also be encouraged to apply self and peer assessment to evaluate their progress employing REA in real-world contexts across their disciplines of study. Hence, REA potentially invokes an approach to thinking about how we might develop a set of six advanced three-hour workshops to accompany a short service learning component for our students.

PARTICIPANTS

The project is directed by a six-member faculty team spanning three colleges in the university:

- Two industrial engineers with research expertise in renewable energy and sustainable development and supply chain management and sustainable manufacturing, respectively, bringing additional research emphasis in engineering education.
- Two environmental engineers contributing research and teaching specializations in air quality and water quality, respectively, with over-arching experience in collaborative projects and team management.
- A sociolinguist who teaches in a bilingual education program and has expertise in transdisciplinary research, communications, and adult/organizational development.

- An anthropologist whose training and scholarship lie in community-based approaches to research and teaching, including service learning, qualitative research methodologies, public humanities pedagogy, and higher education research.

The workshops were principally developed collaboratively by the anthropologist, sociolinguist, and an industrial engineer, with input from the other project faculty. Each workshop was team-led by the sociolinguist, anthropologist, and one of the other faculty team members, in rotation.

The student participants comprising the first cohort in the program included master's and doctoral students from psychology (1), counseling (1), sociology (1), environmental engineering (2), industrial engineering (1), mechanical engineering (1), and sustainable energy engineering (3).

TRANSDISCIPLINARY EDUCATION WORKSHOP MODEL

Participants in the workshops engaged in (a) two cultural competence workshops, (b) two community engagement workshops, and (c) two qualitative data analysis workshops. We describe the structure and design of key elements in the workshops below. In the tradition of ethnographic writing, we include "rich descriptions" of simulations carried out during the workshops, which offered relational spaces to apply the conceptual frameworks and methods introduced in the workshop toward transdisciplinary solution-seeking processes around climate change. The intent in providing detailed explanations of the workshop module components is both to provide context for this paper's data and findings, and also to disseminate the structure for wider audiences and applications at other institutions.

A. Cultural Competence Workshops

In the first two three-hour workshops, students built their knowledge and self-awareness of intercultural competence, with the goal of identifying their own ethno-relative perspective and enhancing their relational awareness in their intra-actions with others. Prior to the workshop, students completed a Big Five Personality test, bringing their results to share. In small groups, the students considered their own relation to openness-closedness to experience, conscientiousness-not conscientiousness, extraversion-introversion, agreeableness-disagreeableness, and emotional stability-neurosis [10]. Simulating the transdisciplinary frameworks needed for climate change solutions, the students then collaborated in small groups to construct a "large ecofriendly structure for a superdiverse urban environment experiencing global warming," using only hands, paperclips, and a ream of white paper (Figure 1). Their self-descriptions of the structures they created ranged from metaphors of an octopus with tentacles representing various sustainable living sources, to a self-contained waterworks green ecosystem, to philosophical pillars of a society's norms and values. They interpreted their contributions and collective outcomes vis-a-vis the personality traits previously shared.

To these initial intra-actions, the students then mapped their cultural orientation, self-assessing their perspectives on key continua by physically and spatially placing themselves along a metaphorical line in the room (Figure 2). These cultural orientation continua included:

monochronic-polychronic, low-high contexts, individualistic-collectivistic, egalitarian-hierarchical, task focused-relationship focused, surfacing differences-maintaining harmony, emotionally restrained-emotionally expressive, and being-doing [11], [12].

Figure 1: Example of ecofriendly structure for a superdiverse urban environment experiencing global warming.

Figure 2. Students place themselves along a metaphorical line in the room

Finally, students began a Johari Window exercise, in which they self-assess and discuss what they knew about themselves and what others knew about them, as well as what others knew about them and what they didn't know about themselves. They took field notes on an introduction to Robert Kegan and Lisa Lehey's theory of adult and organizational development concerning three broad forms of consciousness, also referenced as plateaus: the socializing mind; the self-authoring mind; and the self-transforming mind. The workshop facilitators then presented two separate autoethnographic vignettes using the three forms of consciousness. The first vignette was linear, where one form of consciousness developed after the next. The second vignette was nonlinear, where tropes from each of the three forms were present to varying degrees throughout.

The value of developing intercultural competence, the ability to effectively communicate, interact, and work with people from diverse cultural backgrounds, potentially contributes to greater equity in several ways. First it fosters an understanding and appreciation of diverse

perspectives, values, and practices. This potentially generates the conditions for people to be less likely to engage in discriminatory or prejudicial behavior, thus promoting equity. Second, by workshop participants beginning to collaborate with each other and share diverse experiences and viewpoints with one another, individuals are more likely to recognize and challenge their own biases, leading to fairer treatment for all. Third, the workshops emphasized clear and respectful communication which promotes collaboration and cooperation, contributing to equity by ensuring that everyone's perspectives are heard and valued. Fourth, by emphasizing an understanding of the unique needs and challenges faced by differences within the classroom workshops, participants potentially realize how meetings, collaborations, organizations and institutions might develop more inclusive policies and practices that promote equity and diversity. Fifth, through the practice of consensus decision making and talking stick, participants practiced and role-played addressing conflicts in a fair and respectful manner, which nurtures equity and harmony within diverse communities.

B. Community Engagement Workshops

The next two workshops emphasized community-directed research as an important framework for maximizing the benefits of applied research. Two community engagement workshops provided a definitional discussion of transdisciplinarity and stakeholder engagement strategies for transdisciplinary collaboration. In the first community engagement workshop, students were introduced to a four-stage model for initial transdisciplinary collaboration [13]. To model transdisciplinary applications to community-engaged solution-seeking to environmental challenges, the students simulated a case study scenario involving an action plan for climate change. In the first stage of the model, students individually read a document that simulated a community stakeholder - in this case, a city agency requesting assistance in drafting a city action plan to combat climate change issues in a coastal community. The students individually highlighted lexical items of significance in the document. Subsequently, they worked in small groups to create one master list of focal themes that emerged in the city agency's request for input on the need for a climate change action plan.

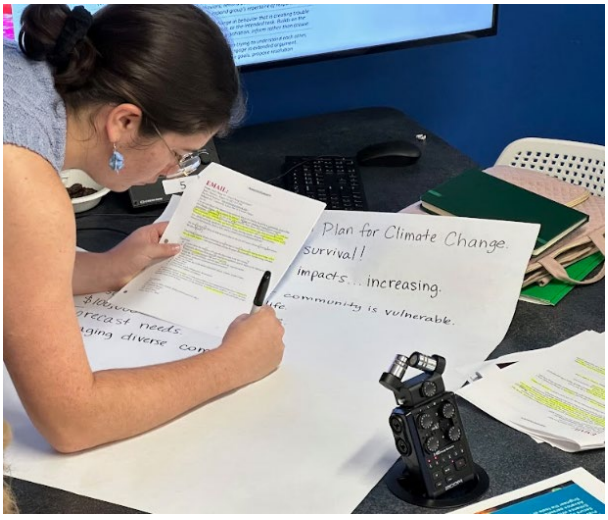

Figure 3. Student codes a document in a climate action plan simulation

In the second stage of the four-stage transdisciplinary model, they sorted those focal themes by whether they pertained to human systems, natural systems, or any additional categories they co-constructed. Using those categorizations, in the third stage they iteratively reviewed the source document from the city agency to create higher order, or "big," questions which would guide the drafting of an action plan. In the fourth stage, the students were introduced to consensus decision-making strategies, including processes of agreement, acquiescence, and disagreement with negotiation. The entire cohort of students then used consensus decision-making to sort and prioritize the big questions to develop strategies to address high-priority questions relating to the need for, and process of creating a climate action plan. Through this simulated exercise in addressing a regional environmental need, students experienced and engaged in the dialogic processes through which transdisciplinarity is co-constructed, utilizing a four-stage model that they can carry forward and use with community stakeholders in their future work as environmental professionals.

The second community engagement workshop introduced 11 themes to support intra-actions within and across diverse community stakeholders. These themes include deep listening, questioning, sharing information, cultivating agreement, rewarding stakeholders for effort, demonstrating empathy, keeping the discussion focused, summarizing, gatekeeping, modeling preferred behaviors, informing others about discrepancies, and mediating conflicts. The workshop also introduced a checklist for developing an engagement plan and five engagement goals, including the sharing of clear information about an issue to diverse communities; consulting with community stakeholders; involving community stakeholders in decision-making; collaborating; and empowering communities. The value of focusing upon community engagement strategies is to bring forward the students' interest, methodological tools, and skills to harness the value that comes from more equitably including the voices, needs, and "funds of knowledge" of diverse community members, in service of stronger solution-seeking to our complex socioenvironmental issues.

C. Qualitative Data Analysis Workshops

The last two workshops introduced the basic epistemological and methodological differences between quantitative and qualitative research. They focused primarily on qualitative data analysis, an iterative process of noticing things, collecting things, and thinking about things [14] as well as an understanding of transdisciplinary rapid ethnographic assessment via interviews and focus groups. Students explored a comparison of qualitative and quantitative approaches to research along different themes including goals, design, sample, data, methods, the role of researcher, data analysis, and academic affiliations. Students were introduced to the importance of data collection (e.g., interviews, observations, field notes); data management and preparation; and data analysis and interpretation.

In the first qualitative data analysis workshop, students engaged in initial inductive coding activities and memoing. To simulate applications of qualitative coding of a stakeholder-engaged environmental focus group, they conducted line-by-line coding of an excerpt of a transcript from a Nuclear Regulatory Commission Public Meeting, held in 2021 in Paris. Students used in vivo, process, descriptive, structure, and values coding to create coded lexical items from the

transcript. Students were introduced to consolidating codes into categories and categories into themes, actions, and processes, as well as triangulation of different sources such as interviews, observations, and documents.

The second qualitative data analysis workshop emphasized how qualitative methodological tools, including field notes, interviews and focus groups, help to internally define needs, priorities, and outcomes, an approach that is particularly relevant in transdisciplinary, stakeholder-engaged solution-seeking to complex environmental challenges. Interviews were introduced as one-on-one, in-depth discussions to explore experiences and understand problems, behaviors, motivations, and challenges. Students learned about semi-structured and structured interview guides and different types of interview questions (e.g., descriptive, experiential, perceptual, and structured foci for interview questions). In a simulation, students practiced taking field notes on a short video talk by a community activist whom they will meet and work with during their service-learning projects that are planned to follow the first six workshops. Next, they utilized those field notes to construct interview questions, simulated as if they were conducting door-to-door neighborhood qualitative surveys of coastal community residents regarding their attitudes toward climate change and the need for a city action plan to combat climate change.

Together, the three cultural competence, community engagement, and qualitative data analysis themes provided iterative intra-actions that included reflective activities, like writing field notes; dialogic practices, like pair-share conversations; and transdisciplinary applications through simulations. The six workshops also generated intra-actions to co-construct and soft-assemble significant discourse in a variety of simulations.

FINDINGS

Drawing on qualitative data analysis methods, this paper reports findings derived from inductive coding and analysis of student class notes, interviews, and workshop planning. Working as a transdisciplinary qualitative analysis team, the faculty team and paper authors extracted quotes from students' journals and converted these lexical items to codes. After reviewing all the codes, the next level of data analysis included converting the codes to themes. Ongoing participant validation strategies were deployed through dialogic engagement. Here, we report the results of our data analysis of the three workshop thrusts, in the order in which they were given: cultural competence, community engagement, and qualitative data analysis. In addition, student participants' survey responses were compared with a corresponding control group of non-participants.

A. Cultural competence

Eight themes emerged in participants' attitudes and reflections relating to the intra-actions of the culture competence workshops, including: awareness, collaboration, diversity, culture, transdisciplinarity, coding, social values and skills, and communication. Discussion of each theme, supported by participants' quotes, are presented below:

1. Awareness:

Participants' quotes demonstrated the development of a strong capability of self-awareness and awareness of others among the workshop participants. Students enjoyed the topic and started to pay attention to their feelings and engage in a deeper understanding of different perspectives or characteristics that people have. They saw the *importance of self-awareness and the awareness of others*, which will *help establish boundaries, enhance communication with others, promote connection among people,* and *help achieve their goals*. Representative quotes are provided below.

> "I believe the [Big 5 Personality Test] questionnaire was a bit broad on some of the explanations. For instance, under neuroticism I scored a 13 (high) under anxiety and the description reflected a "fight or flight" system stating people with high anxiety feel afraid of specific situations or generally fearful and I did not reflect that. My anxiety comes more from not being familiar with a task, but I am never fearful of taking on new tasks. I tend to get some anxiety knowing that I have a lot to learn before I can become efficient in the task that I decided to take on. However, I did learn some things about myself in other areas of the questionnaire. I also enjoyed the diversity of my group and their perspective on their own scores. It was great to reflect thoughts with others that have different characteristics than myself. This openness of perspective and feelings on personal characteristics allowed the communication to be more personal and deep. I really enjoyed this first day and look forward to future workshops." (Student 6)

> "I thought it was a good experience. The questions involved were very interesting and it was nice seeing all the opinions. It helped me understand more of my own aspects. Also interesting to see the different perspectives that people have. Awareness overall plays a major role as it can be seen as almost the foundation for communication. If you are aware of aspects such as the culture of one, it can lead to better conversations. No further questions at this time." (Student 2)

> "What I learned about myself is that many people may look at myself and think in many different ways. Then I may see myself in a different light. I believe through life everyone has their own trials, culture, ethnics and experiences that all reflect who and how they are today. Being able to understand all perspectives and ethics is valuable to understanding each person's perspective." (Student 8)

> "I learned about myself using the three stages of adulthood and understanding myself within the three stages. I learned more about my group mates and what their values are. Self-awareness and awareness of others is important to avoid any cultural misunderstanding." (Student 5)

> "I learned that I encompass several values of the 3 stages of the mind discussed by Kegan and Lahey. I learned that others develop at different paces and that their experiences will largely shape the development process. Self-awareness is the first step towards the awareness of others in my opinion. How can an individual be aware of

another's perspective while not being aware of his/her own? The understanding of various perspectives, falling under the "self-transforming mind," is essential to facilitate communication across different cultures. I want to know ways to help myself and others catalyze the process of understanding various perspectives." (Student 10)

"Self-awareness and the awareness of others is essential in establishing boundaries and understandings when communicating. This awareness is very important for the evolution of society towards acceptance and inclusion for all." (Student 10)

"Awareness of others supports communication because you can connect and utilize their strengths to be more successful in your goals." (Student 7)

2. Collaboration:

Participants' reflections show that they developed a good understanding of the meaning and value of collaboration. They highlighted that *collaboration leads to stronger ideas* and beliefs. They also saw *collaboration as a mutual enterprise in dependability*. Representative quotes are provided below.

"I believe it demonstrates seeing things through another person's perspective and not just your own. Combining the faces to make one face shows strength in various perspectives. Strong beliefs and ideas come from a collaboration of perspectives and people. Also shows that what a person sees is based upon what others have reflected onto them to mold them into who they are." (Student 8)

"I was dependable in being someone that my partner could rely on." (Student 5)

3. Diversity:

Students were able to *correlate the concept of diversity with what they have experienced in real-world situations* and *saw the value diversity can bring* to the table. Representative quotes are provided below.

"Last week, I was able to attend a training where I met researchers and professors from different states and countries serving in minority-serving institutions. It was interesting to see their perspectives on how to advance research among minority students. Most professors were from different countries." (Student 1)

"Perspective is crucial." (Student 4)

4. Culture:

Students started to see how *culture shapes people's perspectives* and how *important it is to respective people's cultural differences*. Representative quotes are provided below.

"I got to reflect on how my culture and various groups of people have impacted my perspective of people of other ethnic nationalities. I have also learnt to be open minded

and be receptive to people's cultural differences during my day to day activities. Culture plays key roles in how people perceive each other." (Student 4)

"From the conversations, I understand that because of the differences in our background and culture, people tend to sometimes behave the way they do. Everyone has a good side which we can see and identify if we look deeply without bias and prejudice." (Student 4)

"I learned more about how my cultural differences define me more than what I was aware of. Also, it was interesting to see how all of us have a different perspective on things even when provided with the same instructions. In addition, I had a great time connecting with people from other backgrounds outside of my major/field." (Student 1)

5. Transdisciplinarity:

This theme includes only one quote. This student shows some understanding of transdisciplinarity, but *the lack of quotes from other students might indicate the transdisciplinarity concept is hard to grasp* and *more future training sessions and role play* will help enhance the student's understanding of this important concept.

"Transdisciplinarity is the waiving, braiding, integrating, & synthesizing of different traditions, frameworks, and assumptions from knowledge that has often developed separately." (Student 9)

6. Coding:

Students developed a good understanding of the concept of *coding*, including the application, advantages, and types of coding. They also reflected upon the *use of REA* toward short-term, local issues, particular those affecting under-served populations. Representative quotes are provided below.

"I learnt about how to use coding to analyze data-set, the advantages, and the different types of coding and how they compared." (Student 3)

"Not all indi[viduals] progress through these stages in a linear/predictive manner." (Student 4)

"Rapid ethnographic assessment: qualitative research method that focuses on the collection of analysis of locally relevant data and is used to quickly assess a variety of complex social and structural issues to improve programs & policies impacting marginalized & vulnerable populations." (Student 3)

7. Social values and skills:

Students' feedback indicate that they started some understanding of the *socializing mind* and *self-authoring mind*. Representative quotes are provided below.

> “Socializing mind "actively avoid conflict" "less of a need for validation.” (Student 4)

> “Self-authorizing mind: question assumptions and social values." (Student 4)

> “Self-authorizing mind: I began to recognize some internalized homophobia and other harmful leftover ideas making me feel removed from the community." (Student 5)

8. Communication:

Students’ quotes show that they *understand what is needed to be good communicators* and *how communication can help in community engagement* and *bring communities together*. Representative quotes are provided below.

> “Time (fixed, planned), tolerance (particularistic, universalistic) for ambiguity, power distance, Equality, Hierarchy.” (Student 7)

> "1. Must keep confidence at all levels. 2. Embrace all levels and combine to unite all communities. 3. Individual communities coming together to form a whole infrastructure. Building trust - works both ways." (Student 8)

> “I thought that it was fun and engaging. Everyone was really nice and patient. I am looking forward to attending the next session.” (Student 5)

B. Community engagement

Three themes were identified in students’ feedback, including communication, perspectives and self-awareness, and practice and practical solutions.

1. Communication:

Students viewed communication as *essential* and critical in effective community engagement. They reflected that researchers need to *go out of their comfort zones* in their efforts to be inclusive, *reach participants of different cultures*, and foster *transdisciplinary wisdom*. At the same time, they noted that *communication barriers* can be problematic, and that it can be challenging to *find common ground*. They appreciated the *four-stage model for transdisciplinary collaboration* as a mechanism for structuring and addressing complex issues in a systematic way. Representative quotes are provided below.

> "Students’ Communication is essential and critical to get the communities to participate, “understand a wider range of perspectives”, and minimize the “negative impacts.” In order to communicate effectively, researchers need to go out of their comfort zones, and reach out to participants from different cultures. From Armon’s video, participants learned how to overcome “safeguarding livelihood” and “preserving cultures”, how to “leverage strengths of diverse communities”, and how to get “collective transdisciplinary wisdom.” The communication barriers could come from “language, gender, race, multilingual culture, or indigenous.” (Student 7)

> "Staying in your lane can contribute to the problem. How can you communicate with someone who was raised differently from you? How can we find common ground? Engagement, think across disciplines." (Student 7)

> "I found the 4-stage approach to transdisciplinarity in the workshop to be highly beneficial. It offered a structured framework for addressing complex issues, and ensuring a systematic approach." (Student 2)

2. Perspectives and Self-Awareness:

Most quotes from the students show that the workshops inspired the students to *consider their own perspectives on community engagement* and *realize what they learned* from the workshop. The workshops also helped the students to *learn new perspectives* when they consider community engagements, which hopefully will *help the transdisciplinary solution seeking* processes in the future. Representative quotes are provided below.

> "Today's workshop has helped me understand how to really create a consensus between different people with different perspectives. This has also helped broaden my previous ideas of solutions to climate change and the issue of climate change in the first place." (Student 7)

> "I feel that I am already fairly good at finding the origin of problems, interpreting problems, and looking into practices surrounding problems, but I have gotten better at it. However, the mediating and solving problems and problematic practice stage is something that I feel that I need to work on. One new direction that I feel that I would need to take to improve in this area would be to try to speak up more." (Student 5)

3. Practice and Practical Solutions:

Most of the quotes under this theme reflect students' thoughts and ideas of *engaging communities in the real world*. The simulation case study used in the two workshops helped significantly to inspire students' thinking about *practical means through which to engage communities* in solution-seeking processes affecting their natural and social environments. Representative quotes are provided below.

"Today's workshop was particularly helpful because we were put into a situation where we all had to reach a consensus in order to reach a decision on how to come up with a climate change plan for Corpus." (Student 5)

"The simulation of community stakeholder engagement using the 'five engagement goals and an engagement toolbox' was valuable. It allowed us to practically apply key engagement goals and provided effective tools. To enhance the workshop, consider more opportunities for group discussions and practical application to projects." (Student 2)

C. Qualitative Data Analysis

Four themes emerged from student data that stress the methods students learned and their use in adopting and promoting transdisciplinary approaches to climate change solutions. These themes include interview question development, coding, field notes development, and focus groups.

1. Interview Question Development:

To simulate applications of qualitative data tools toward a community-involved environmental issue, students wrote *practice interview questions* to ask community residents in a door-to-door qualitative survey fashion. Representative quotes are provided below.

> "What are some protocols that you think could assist our area with being better prepared for climate change effects?" (Student 8)
>
> "How do you feel about our city creating an action plan for climate change?" (Student 7)
>
> "Can you describe your experiences concerning climate change? Do you recall the negative consequences you have lived due to climate change in the Coastal Bend? What are your productive or labor activities in the Coastal Bend?" (Student 6)

2. Coding:

The importance of coding stands out as another theme. Students had two workshop opportunities to code. They coded book covers and a transcript from a public discussion of the Nuclear Regulatory Commission. Both activities focused on issues around environmental justice. A common thread in this theme was the *multiplicities of meanings which can emerge in qualitative data*, as well as the *strength of coding for identifying key thrusts and themes in source material*. Representative quotes are provided below.

> "I learned that there isn't just one way to code." (Student 7)
>
> "Coding is a way to summarize and outline important ideas in a document." (Student 3)
>
> "Coding makes easier the research process." (Student 1).

3. Field Notes Development:

Field notes development was another key theme. Students noted the *importance of leveraging and empowering marginalized community stakeholders*. Representative quotes are provided below.

> "Field notes on video message from Mr. Armon Alex: call to action a climate action, strategic roadmap ==> policies, diverse array of stakeholders ==>leverage strength of diverse community ==> marginalized groups. Innovative solutions that create opportunities not just a policy." (Student 4)

4. Focus Groups:

The procedure and process of focus groups were discussed and then experienced by the student cohort, such that students were given opportunities to talk about the workshops through the model of enacting a focus group. Their feedback indicated the *utility they saw in focus groups as a mechanism for individual and group feedback*, as well as the *value they placed on open-ended discussion* and *spaces for collective expression and experience.*

> "The focus group allowed for open ended discussion which enabled everyone the opportunity to provide individual feedback and cohesive feedback. I appreciate how it allowed us to see the collective experience of each individual." (Student 6)

D. Workshop Evaluation Based on Cohort Survey and Control Sample Responses:

In the Fall 2023 semester, we had 12 graduate students in our first cohort. Pre- and post-surveys were conducted to obtain students' feedback. We received 12 responses in the pre-survey, 8 responses in the post-survey, and 12 responses in a baseline survey with the same questions from graduate students who did not participate in the workshops. In the survey, the students were asked to indicate the best descriptor of their confidence in their ability to perform each of the following 18 tasks:

Task #1: Creates problem statements showing an understanding of key issues to address;
Task #2: Applies various principles to achieve analytical or simulation models when formulating the problem;
Task #3: Identifies constraints on the problem and establishes criteria for acceptability and desirability of solutions;
Task #4: Produces a clear and unambiguous needs statement in a service-learning project;
Task #5: Evaluates and analyzes the cultural, economic, social, and environmental impacts of a problem solution;
Task #6: Uses data analysis techniques to characterize and respond to community needs in solution-seeking processes;
Task #7: Uses style format appropriate to the stakeholders with graphics that are attractive, clear, and easy to interpret;
Task #8: Enhances communication via body language and choice of speech;
Task #9: Recognizes roles in a team setting and fulfills appropriate roles to assure team success;
Task #10: Improves communication among teammates, asks for feedback, and uses suggestions;
Task #11: Reflects attitudes beneficially on Service Learning Benefit Scale;
Task #12: Observes good community practice and operates professionally at the level of community participants;
Task #13: Determines data that is appropriate to collect and selects appropriate equipment, protocols, etc. for measuring the appropriate variables to get required data;
Task #14: Uses appropriate tools to analyze data and verifies and validates results;
Task #15: Ability to incorporate intercultural skills in identifying and describing complex real-world problems utilizing principles of engineering and science;

Task #16: Ability to produce or enhance solutions with consideration of specified community needs, especially cultural, social, environmental, and economic factors;
Task #17: Ability to communicate and function effectively within a team whose members have different educational and cultural backgrounds and consist of a range of community stakeholders;
Task #18: Ability to engage community stakeholders and use mixed research methods to gather, analyze, and interpret data to draw conclusions and conduct appropriate engineering design.

The confidence levels were described as Not Sure (0), Not Confident (1), A Little Confident (2), Somewhat Confident (3), Confident (4), Very Confident (5), and the average values of the responses are reported in Table 1. First, comparing the results from pre-survey and baseline survey, the first cohort shows similar responses with non-participation students, except tasks 4, 6, and 13, which are related to community or qualitative research. One of the possible reasons is that there are more students with a sociology or psychology background in the baseline survey. By comparing the results from pre-survey and post-survey, participating students' confidence levels have increased for completing most tasks except task 17. By comparing the results from the post-survey and baseline survey, students who completed the workshops show high confidence levels in most tasks, except tasks 7, 12, and 17. These observations may be due to the small sample size. However, we will try to improve our workshop materials to address these tasks, especially task 17.

Table 1: Summary of Survey Results

Tasks	Pre-survey	Post-survey	Baseline	**Tasks**	Pre-survey	Post-survey	Baseline
1	3.583	4.375	3.750	**10**	3.750	4.250	3.917
2	3.500	4.375	3.500	**11**	3.417	3.500	3.500
3	3.750	4.125	3.667	**12**	3.667	3.875	3.917
4	3.333	4.125	3.750	**13**	3.250	3.875	3.833
5	3.634	3.750	3.333	**14**	3.417	4.125	3.667
6	2.818	4.000	3.667	**15**	3.250	3.500	3.250
7	3.273	3.625	3.750	**16**	3.333	3.750	3.417
8	3.545	3.750	3.583	**17**	3.667	3.625	3.917
9	4.167	4.125	3.917	**18**	3.167	3.500	3.000

DISCUSSION AND CONCLUSION

This paper *reports the design and results of a six-part workshop series* (Research Question 1) which was collaboratively created and delivered with the intent of fostering transdisciplinary education that can meet the 21st century challenges we face to our natural, social, and engineering systems. The goal was to pilot and test whether education in cultural competence, community stakeholder engagement strategies, and qualitative data analysis could transform graduate students' confidence and ability to conduct transdisciplinary research that helps reach sustainable solutions to local and translocal problems that resonate globally.

Upon analysis of student data collected before, during, and after the workshop series, the project team identified a range of learning outcomes and areas for future revision (Research Question 1). Workshop participants identified that self-awareness and awareness of others plays a major role in cultural competence, communication, and social skills. Self-awareness of one's own subject positioning, including within the three stages of adulthood by Kegan and Lahey, is important to avoid any cultural misunderstanding. Student data indicated that this self-awareness encouraged students to open up and become better communicators about their feelings. In turn, being aware of the culture of others led to deeper, more meaningful conversations and relational exchanges. This ethno-relative perspective supports communication and allows the use of their strengths to more successfully achieve goals through diversity and collaboration.

Student reflections on the community engagement workshops indicated that the intra-actions of the workshops inspired most students to think about the importance of engaging communities during solution-seeking processes. Students particularly noted the importance of leveraging and empowering marginalized community stakeholders. They felt they learned fundamental skills for engaging communities, including the utility they saw in focus groups as a mechanism for individual and group feedback, as well as the value they placed on open-ended discussion and spaces for collective expression and experience. They reflected upon the multiplicities of meanings which can emerge in qualitative data, as well as the strength of coding for identifying key thrusts and themes in source material. Additionally, students highlighted the value of communication in stakeholder-engaged interactions and noted their own enhanced communication skills. Overall, student feedback indicates the utility and impact of the six-part workshop series.

By increasing students' awareness of the importance of community, and inspiring students to consider more diverse and inclusive perspectives during solution-seeking processes, it is *expected to enhance students' interest and ability to conduct transdisciplinary approaches for seeking sustainable solutions (Research Question 2).* With such transdisciplinary research, we move from sharing different analyses or creating new applications to creating a space for shared dialogue, leading to a joint analysis using new approaches that could not have existed without the crisscrossing of ideas to knit a new web of knowledge and form novel frameworks to catalyze scientific discovery and innovation.

We will continue analyze different types of data collected to evaluate the effectiveness of the workshops, including (1) participant surveys completed prior to the workshop series commencement and at the conclusion of the series; (2) surveys completed by students at the conclusion of each individual workshop, and (3) audio transcripts of participants engaging in a focus group at the culmination of the workshop series. A sub-group of the workshop participants will continue with another set of advanced workshops in the following semester and practice their skills in a service-learning project with community partners. Figure 4 below shows the overall concept and long-term goal of the project. The entire project is expected to recruit around 40 students over three years. More widely, this model is scalable and adaptable at other institutions as a co-curricular offering, running in tandem with proscribed degree plans, in support of innovative graduate student development that helps prepare and equip the next generation of environmental professionals.

Figure 4: Overall concept and long-term goal of the project.

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