The Formation of Engineers to Address Wicked Problems (FEW) Model: Investigating Impacts of a Humanitarian Engineering Minor on Students' Intercultural Competence

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Abstract

This effort explores the challenges of addressing complex global sustainability issues, known as Wicked Sustainability Problems, emphasizing the need for engineers to take and understand interdisciplinary approaches to navigate stakeholder disagreements and dynamics through the development of intercultural competence. The Humanitarian Engineering (HE) minor program at The Ohio State University is designed to equip future engineers with skills beyond technical expertise to prepare them to address such challenges was the foci of this effort. A multi method approach was taken to explore to investigate potential impacts of student curricular pathways and experiences in the HE minor program on students' intercultural competence, using quantitative data provided by pre and post student results from the Intercultural Development Inventory (IDI) and qualitative insights from semi-structured interviews, focus groups, and course artifacts. While a longitudinal research effort is underway, the preliminary findings presented here highlight that students completing the HE minor experienced increased intercultural competence, fostering their ability to understand stakeholder values and navigate societal complexities, but that further research efforts are required to correlate specific drivers of intercultural competence development in engineering students. A conceptual framework, the Formation of Engineers to Address Wicked Problems (FEW) Model, is proposed to highlight pedagogical structures that integrate the desired educational outcomes effectively and is built on prior literature and similar conceptual frameworks within the Engineering for Sustainable Development and Intercultural Competency domains. This paper highlights the importance of preparing engineers to address multidimensional challenges from an interdisciplinary approach while positioning Humanitarian Engineering as potentially an effective pedagogical process to prepare engineers to address sustainability related challenges.

Introduction

The most urgent global sustainable development challenges—from adapting to climate change to creating affordable housing to providing safe and accessible water—are complex problems without clear boundaries. Because they defy simple resolution, such challenges have come to be known as wicked problems [1]. One of the difficulties of addressing wicked problems is the underlying complexity that stems from fundamental disagreements among stakeholders concerning both the root of the problems and best potential approaches to tackling them. Addressing such challenges requires interdisciplinary and transdisciplinary approaches from a variety of backgrounds and fields to navigate the complexities of stakeholder values and dynamics [2]. This requires that the next generation of scientists and engineers think and problem-solve in new ways.

As engineers play a significant role in addressing such challenges, they must be equipped with capacities beyond the traditional technical focus. To fit this need, engineering educators have reexamined curriculum and have worked to create programs that provide students with opportunities to understand multidisciplinary perspectives, learning concepts from the social sciences and developing critical design skills [3]. Programs with such foci have been growing and over 85 academic institutions worldwide provide learning opportunities that aim to develop such capacities in students [4]. These programs have a range of foci and use a variety of different terms to name their fields of study, including 'Humanitarian Engineering,' 'Global Engineering,' 'Engineering for Good', and 'Engineering for Sustainable Development' [5]. A significant aim of these programs is the development of global sociotechnical competency, conceptualized to highlight that the social and technical aspects of an engineering project cannot be separated and must be considered as such [6]. As a wide range of perspectives are required to address the complexities of wicked problems [7], engineers with global sociotechnical competency are poised to make critical contributions to global sustainable development challenges [5].

The mission of the Humanitarian Engineering (HE) Program at The Ohio State University (OSU) as stated within the program mission document is to *"educate students on the application of science and engineering to address **complex societal challenges** with an emphasis on collaborating with communities to achieve their desired vision of well-being through a curriculum grounded in proven theories of **sustainable development** and **applied engineering and socio-cultural learning experiences**."*

The Humanitarian Engineering (HE) minor was created specifically with the intention of training students to develop the skillsets required to address complex societal challenges, with student learning outcomes related to development of Intercultural Competence. The HE minor has been offered for the past decade, with courses focusing on community-based learning, social justice, Water, Sanitation, and Hygiene (WaSH), other relevant topics related to sustainable development [8]. Recently, recently a programmatic revision was conducted to center the program's relationship to external partners as well as offer a scaffolded educational experience to facilitate the program's student learning outcomes [9]. While there are a number of HE course offerings and a recently established an HE lab [10], there has been limited formal investigation into the

experiences of students pursuing and completing the Humanitarian Engineering minor at X. For this reason, this study investigated the impacts of this HE minor related to a key dimension of global sociotechnical competency: intercultural competence. This concept is defined as the lifelong process of developing targeted knowledge, skills, and attitudes leading to behavior and communication that are both effective and appropriate in intercultural interactions [11], [12]. The framing of this research was guided by the Development Model of Intercultural Sensitivity (DMIS) [11], [12]. The DMIS is structured via the Intercultural Development Continuum (IDC), consisting of five phases with each phase building to transition from ethnocentric mindset to the intercultural mindsets. [11] Individual positionality along the IDC is assessed by the Intercultural Development Inventory (IDI®). The (IDI) was utilized as a quantitative measure to assess student's intercultural competence. It is cited as one of the most robust and valid measures of intercultural competence.[11] As the IDI and IDC do not consider the direct dynamic between intercultural competence as it pertains to engineering design, the Engineering for Social Responsibility framework was incorporated to investigated potential linkages present within the Teaching and Learning Assessment methods of incorporating wicked problems into engineering design.

This study aimed to address the following research question:

Do students who participated in the HE minor demonstrate an increased intercultural competency as measured by the Intercultural Development Inventory (IDI)?

This effort leveraged a multi methods approach with quantitative data collected via the Intercultural Development Inventory (IDI) and qualitative data gathered in the form of surveys, focus groups, and course artifacts. Findings are presented as the conceptualized framework, Formation of Engineers to Address Wicked Problems (FEW), building on existing research and literature aiming to contribute to the knowledge gap surrounding effective pedagogical practices and methods related to global sociotechnical competency and Engineering for Sustainable Development.

Contextual Background and Positioning of the FEW Model

The ideals that have emerged within the ESD domain focus on considering social justice, political dimensions, structural conditions, and ethical considerations, as well stakeholder understanding, values, and dynamics, which also aligns with ABET-EAC's Criterion 3 Student Outcomes. [5] By providing students an opportunity to learn from and about multidisciplinary and multicultural elements present within engineering design considerations, they can develop, with this approach students will develop intercultural competence and be better prepared to tackle wicked problems [10].

The FEW Model builds upon the current literature and particularly the idea of the engineer's responsibility relating to social elements that even exceed traditional notions of engineering ethics as described with the Engineering for Social Responsibility framework [6]. This drew upon ideas around Engineering global competency [10], [13], [14] that stemmed on the more generalized global competency research. ESR provides an additional step of connection from global competency to engineering global competency. The ESR builds on the three categories established by but also integrates and expands on ethics considerations as well as the relation to the community development and social justice elements presented within. The idea of inseparable aspects of social and technical aspects of engineering and the relationship to engineering skillsets is defined as Global Sociotechnical Competency [15].

Engineers. Engineers are trained to bring complete solutions to technical problems [16], and are not typically known for their social and cultural considerations as they relate to technical problem solving. Often engineering solutions gravitate toward a technical innovation, thus ignoring other relational and contextual elements [17]. There is also ample agreement that engineers must learn how to better engage and work with end users and those who have different background, cultures, values, and lived experiences so that they can practice their profession in an ethical and considerate way as they attempt to have positive impacts on society [6].

Mazzurco and Daniel identify the importance and need of providing evidence and insights into how and if sociotechnical expertise is developed within engineers and through engineering programs[18]. The technical and social dimensions of the engineer's role can never truly be separated, and efforts should be made to investigate the impact programs are having on students' abilities to navigate these dimensions. As professionals, engineers will need to be able to address wicked problems, not just purely technical challenges. Many will also have to consider how to manage complex ecosystems, bring multisector decision making across administrative boundaries, and respect diversity of differences amongst stakeholders. To do this, engineering students must development leadership skills encompassing adaptive management, and conceptualize the historical and contextual power imbalances that have shaped the modern globalized society. Stakeholder values and relationships that result from differing roles, interests, and perspectives can contribute to stakeholder disagreement. This is the driving concept behind the FEW Model: by creating educational and programmatic opportunities that contribute to students' intercultural competence, students can learn to navigate and understand these elements that lead to stakeholder disagreement to effectively address wicked sustainability problems.

Research Design and Approach

Overview

To investigate and gather insights into the curricular impacts of the HE minor on students intercultural competence a multi methods approach was taken, incorporating both quantitative assessment and qualitative data. The data collection took place during the 2021-2022 academic year following the approved IRB protocol 2021E0720. The main study population consisted of undergraduate university students who self-selected and enrolled in the Global Capstone and other courses in the Humanitarian Engineering minor (N=23). A variety of engineering majors were represented in the study, establishing multidisciplinary foci. The data analysis followed a two-phase process. In the first phase, the quantitative and qualitative data were reviewed with the IDI data assessed for changes in intercultural mindsets, and the qualitative data assessed and coded. In the second phase, a subset of IDI data profiles were selected based on noteworthy changes to intercultural mindsets, and further investigation of qualitative data related to each individual case was used to explore IDI data findings in this subset of profiles. The three cases described in-depth in this paper were selected as representative samples of pathways through the HE minor and varied outcomes related to trends in intercultural competence over time.

Quantitative Data Collection

Quantitative data were collected utilizing the Intercultural Development Inventory (IDI) to establish insight into students' intercultural competence. The IDI has been widely used in educational institutions to assess intercultural competency and has been recommended by higher education organizations such as the American Council on Education [19]. The IDI, a 50-question survey, was implemented as a pre and post assessment in various courses IDI scores range from 0 to 150 and provide students with insight into their Development Orientation (DO) stages, correlated to the Intercultural Development Continuum (IDC), a continuum that starts at Monocultural/ Ethnocentric Mindset and moves towards an Intercultural Mindset. The phases are Denial, Polarization, Minimization, Acceptance, and Adaption, as mapped and described further in Figure 1 below.

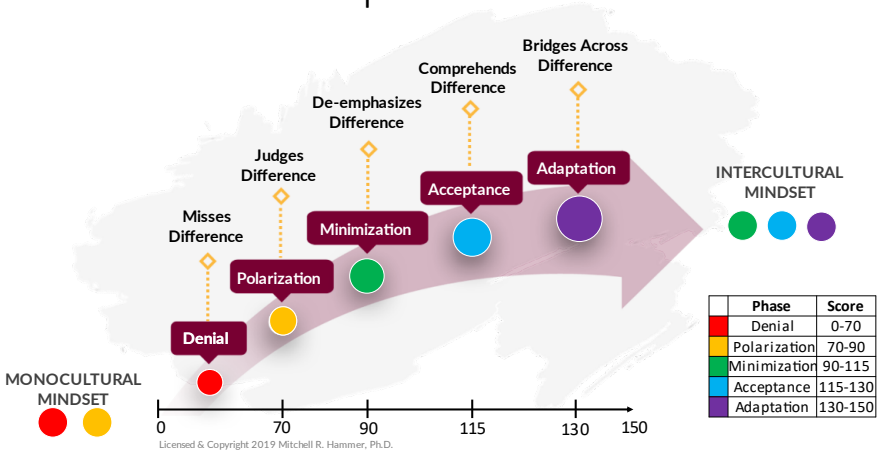

Figure 1: Intercultural Development Continuum and IDI Scores

Quantitative Data Analysis

IDI datasets of student that completed the HE minor were selected from a broader IDI dataset. Quantitative analysis was conducted to detect changes intercultural competence, specifically evaluating if shifts from orientations within Monocultural Mindset to Intercultural Mindset utilizing the Intercultural Development Inventory IDI scores that were generated via the IDI software. These scores correlate to produce reports detailing individual and/or group results that provide insight into characteristics within each phase. These results were then assessed using Microsoft Excel's statistical toolset to analyze the changes across the IDC continuum of the overall group, subgroups, and individuals. Changes (+/-) 7 on the IDI scoring are considered statistically significant.

Qualitative Data Collection

Qualitative data were collected from a modified Student Assessment of Learning Gains (SALG) Survey, developed using the SALG assessment tool [20] with reflection activities guided by [21], and course artifacts including student assignments, focus groups, individual interviews, class discussions, reflection activities, and related project deliverables.

Qualitative Data Analysis

Qualitative data from focus group discussions, assignments, interviews, and field notes were assessed for themes incorporating methods grounded in Narrative Analysis [22]. The qualitative focus group and course artifacts data were examined with the goal to uncover relationships to changes seen within the quantitative IDI datasets to identify contributing factors to student experiences.

Results

The quantitative data set (IDI) was used to inform the qualitative data analysis. Multiple sub cases representative of trends within the data set were selected and are described below with excerpts of the qualitative data provided as insight into intercultural mindset.

Students within the data set who completed the Humanitarian Engineering Minor saw, on average, increased statistically significant increased IDI scores and shift in their mindsets related to intercultural competence. As seen in Table 1, HE Minor students had an average IDI Time 1 Development Orientation (T1 DO) of 91.7 increasing to Time 2 Development Orientation (T2 DO) of 99.3 for an average growth of 7.6. Six students transitioned from their T1 DO Orientation phase to a higher Orientation phase at T2. Two students remained in their orientation phases and two students saw a decrease in their orientation phases.

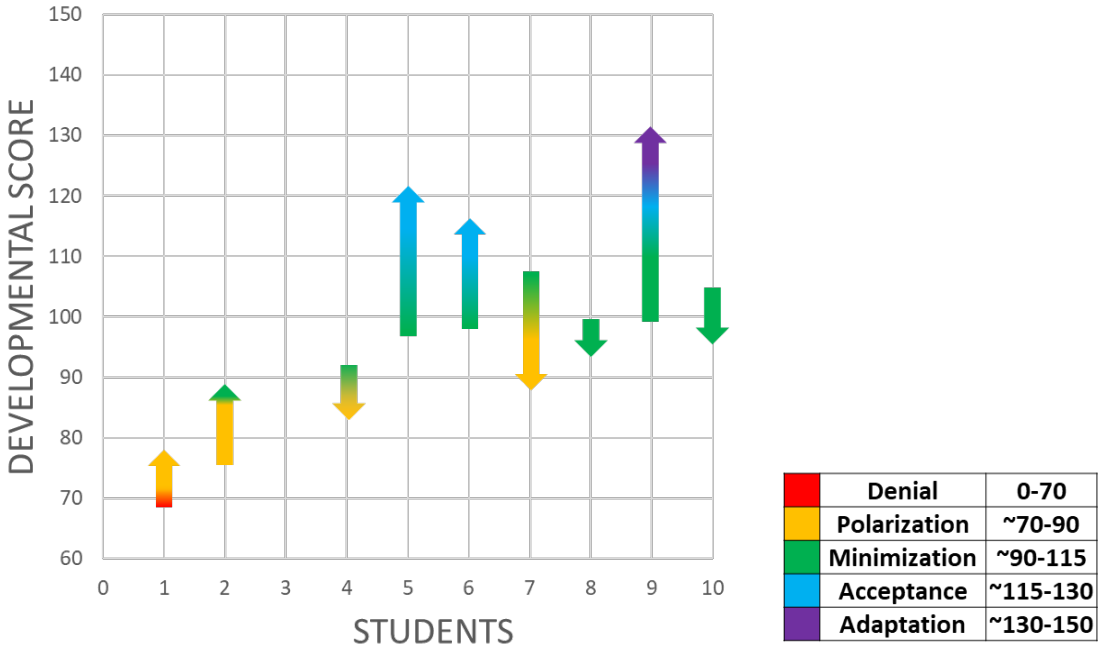

Figure 2: Humanitarian Engineering Minor Student IDI scores

Student	T1 DO	T1 Orientation	T2 DO	T2 Orientation
1	68.18	Denial	76.19	Polarization
2	78.01	Polarization	88.74	Minimization
3	78.44	Polarization	102.5	Minimization
4	92.04	Minimization	84.8	Polarization
5	97.94	Minimization	121.6	Acceptance
6	98.58	Minimization	115.6	Acceptance
7	98.79	Minimization	78.98	Polarization
8	99.36	Minimization	95.73	Minimization
9	99.45	Minimization	131.3	Adaptation
10	106.37	Minimization	97.99	Minimization

Table 1: Humanitarian Engineering Minor Students IDI Scores

Case 1: *(Student 9)– White, female, Biological Engineering with Humanitarian Engineering Minor, Minimization to Adaption*

Student 1 completed the HE minor pathway by taking multiple HE centric courses at various points throughout their academic career. This student started with a Development Orientation (DO) in the Minimization orientation at Time 1 – September 2021 (T1) and achieved a growth of 31.8 points to finish in Adaptation by April 2022 T2 DO. The student exhibited their Adaptation orientation within the qualitative data noting insights into the stakeholder values present within their projects, the complexities of design outside their cultural dominant group, and the challenges that accompanied their efforts. This was demonstrated by the following quote.

"Something that surprised me, was my results (IDI) that I don't find any culture within myself. which I found really funny, actually. But then I was trying to find that aspect of myself. A lot. Because I realized, that if I don't know my own culture, how am I supposed to recognize it (while designing for others)?"

Case 2*: (Student 3), White, Male, Civil Engineering with Humanitarian Engineering Minor, Growth to Minimization*

Student completed the HE minor pathway in a manner that slightly differs with what was proposed above. This case took a majority of the HE minor courses in their final year of coursework. Qualitative data and quantitative data support that growth related to intercultural competence occurred and insights into navigating stakeholder values and dynamics were also demonstrated. This student started with a Development Orientation (DO) in the Polarization orientation at Time 1 – September 2021 (T1) and achieved a growth of 24.08 points to move into

the Minimization Orientation by April 2022 T2 DO. The following quote highlights this students' insights into their own intercultural abilities and their relation to the role of an engineer.

"We live in an ever-expanding world where we get the opportunity to talk and work with people from all kinds of cultural backgrounds. As an engineer it is my responsibility to work in the best interest of the public, and that simply wouldn't be possible if 1) I wasn't able to effectively understand and work with coworkers of different backgrounds, and 2) If I couldn't understand cultural values and their differences among the people I am supposed to work for. This ties a lot into what I need to continue developing, as intercultural competence is not something you just learn and never forget. The world and all the people in it are continuously changing, so to make sure that I continue to do my best work while keeping everybody's wants and needs in mind is something that is going to require me to continue learning, evolving, and seeking out discomfort in my everyday life."

Case 3: *(Student 7), White, Female, Agricultural Engineering with Humanitarian Engineering Minor, Minimization to Polarization*

Student completed the HE minor pathway that differed from the pathway proposed above. This case took a majority of the HE minor courses before their final year of coursework but not in the proposed scaffolded learning structure. Quantitative data suggest a decrease of intercultural competence while qualitative data does not indicate growth or decrease. This student started with a Development Orientation (DO) in the Minimization orientation at Time 1 – September 2021 (T1) and recorded a decrease of -19.24.08 points to move into the Polarization Orientation by April 2022 T2 DO. Qualitative data provided limited insight into this phenomenon. There was partial representation of the Polarization orientation through the quote seen below and demonstrated aspects of increased self-awareness with the second quote.

"I learned the importance of reflecting on the way I think to ensure it is in line with my values."

"I learned that many times I communicate with low context, but people many times need higher context to actually understand what I'm trying to communicate. I'm trying to recognize what is best for each situation and not just assume people understand when I communicate with low context."

Discussion and Model for Formation of Engineers to Address Wicked Problems (FEW)

Revisiting the research question, *do students who participated in the HE minor demonstrate an increased intercultural competency as measured by the Intercultural Development Inventory (IDI)?*

Students within the dataset that completed the Humanitarian Engineering minor on average saw increased levels of intercultural competence. Qualitative data and quantitative data support that growth related to intercultural competence occurred and that understanding of intercultural

competence was achieved, particularly highlighting the capacity achieved to understand their own perspectives while also valuing differences and gaining insight into navigating stakeholder values and dynamics. This research highlights the individuality of intercultural learning with engineering education as not every student was impacted in a similar manner. The data support that the inclusion of these concepts into engineering courses can result in growth related to intercultural competence for students across a wide array of demographics and predisposed levels of understanding. Students that completed the Humanitarian Engineering minor in alignment with the proposed pathway saw increased intercultural competence, further supporting the aim of scaffolding and compounding experiential learning opportunities for engineering students.

A conceptual model, the FEW Model, Figure 14 is presented that incorporates and build on existing literature within this domain and incorporates aspects of the findings and results of this research effort. By connecting the ideas of wicked problems, intercultural and global competence, ABET criteria and Engineering for Sustainable Development aspects, and Bloom's Taxonomy, a model is proposed that considers the formation of mindsets and skillsets engineering students to address wicked problems. The frameworks highlights that it is critical to Address Wicked Problems [FEW] a strong foundation of intercultural competence in engineers must be built, and as their intercultural competence [DMIS] increases their ability to problem solve will also increase as they will have more capacity to engage with stakeholders [ESR] as it correlates with moving through Bloom's Taxonomy [TLA] building Skills, Knowledge, Attitudes and Values [GC].

The critical aspect that is a contribution to the field is the combination of the frameworks within the context of how these educational outcomes (for engineering accreditation as well as growth in intercultural competency) are achieved through leveraging the five categories of the Engineering for Social Responsibility Framework [6], aspects from Teaching and Learning assessment [23], the Developmental Model of Intercultural Sensitivity [12], and the Global Competence Framework [24]

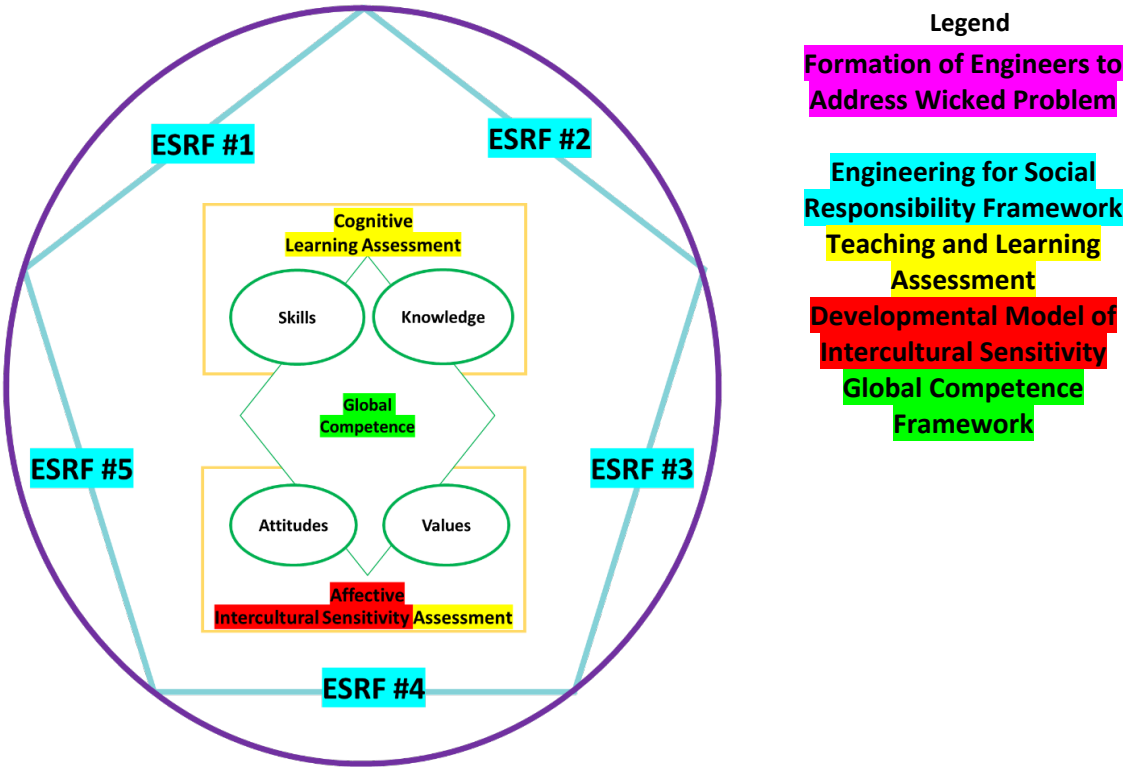

Figure 3: Formulation of Engineers to Address Wicked Problems Model

The proposed FEW Model, Figure 14 addresses the trade offs and balance of educational outcomes intrinsic to the Humanitarian Engineering domain as it relates to the formation of engineering students' abilities to navigate complex society challenges by building their insight and understanding of stakeholder values and dynamics through a foundation of intercultural competence. In terms of relation to the Engineering for Sustainable Development domain; this proposed framework will also shift towards creating an understanding of how to effectively create programs and partnerships to center community value as well as produce engineers who can effectively navigate and address complex societal challenges rather than solely the production of engineers with skillsets to work in a development context. The proposed FEW Model, emphasizes the application and process of mechanism to educate as well as assess whether engineering students within the academic setting are being prepared effectively address wicked problems.

The results demonstrate that student progressing through the Humanitarian Engineering minor saw increased levels of intercultural competence and that the intentional infusion of intercultural learning into engineering curriculum may have contributed to this growth. Results also signal that this is a complex dynamic and not all students were impacted in the same manner and further research and consideration should be given to course and program design.

Conclusion and Future Work

Humanitarian Engineering curricula are well suited to equipping students with the knowledge and skillsets needed to address wicked problems and has even more room to grow. The elements presented within this effort separates HE from traditional engineering education curricula. A perspective shift is further needed within engineering education that cannot view these concepts as a variable to be entered into the engineering design process equation. These mindsets and approaches need to be considered and understood by engineers, especially within the Engineering for Sustainable Development domain. By integrating practices and activities that allow students to build knowledge around stakeholder diversity of values and stakeholder dynamics they can integrate that understanding into the engineering design process. The above practices aim to demonstrate how understanding stakeholder value and the resultant politics that occur from the differentiating values are woven into the educational process by building a thorough understanding of these concepts, students will be able to better understand their positionality as stakeholders and how to engage effectively with others from differing contextual backgrounds as they set out to address the ever-growing list of wicked problems we collectively face.

By presenting the FEW model and highlighting specific practices that can be implemented in Engineering for Sustainable Development focused programs and models will result in more adequately preparing engineering students to navigate and comprehend the politics of engineering involvement in a magnitude of settings ranging from multi-disciplinary, locally focused, multi-cultural, and/or international contexts. The FEW Model also integrates with the immerging Engineering for One Planet Framework (EoP) that highlights the importance of Social Responsibility as it pertains to Sustainability considerations. The position and process of engineers must be questioned as we can longer sit idly by as the world faces “unprecedented” after “unprecedented” challenge where engineers have played the role of problem creator just as often as they have played the role of problem solver.

While the impacts of intercultural competency growth for Humanitarian Engineering minor students appear promising, there are several limitations to consider. The first limitation is the size of the data set; future efforts should establish a control group internally and externally to the institution to assess intercultural growth impacts. An additional limitation is the previous irregularity in the Humanitarian Engineering minor and inability to assess directly if student impact related to intercultural competence may have been positively or negatively influenced by other courses or outside activities.

Future work should focus on the long-term assessment of students pursuing the Humanitarian Engineering minor. Future connections with the Engineering for One Plant Framework (EoP) should also be explored. This should focus on longitudinal studies mapping the career trajectories and development of qualitative tools to investigate the impact that these opportunities may have had had. Further studies should investigate and isolate external factors such as demographic or educational experiences beyond the courses., and in-course experiences, that may be related to intercultural competency development among engineers.

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Appendix A:

Humanitarian Engineering Program Practices and Examples

As part of the investigation into the intercultural competence impacts of Humanitarian Engineering and the contribution to students understanding of stakeholder disagreement and the resultant politics a proposed pathway of an undergraduate student within the Civil Engineering program that is pursuing the Humanitarian Engineering minor is shown. Thus, proposing how this pathway potentially educates students with the capacity to identify underlying sources of wickedness and potential approaches that have incremental solutions. The HE proposed pathway flowchart (Figure 1) is below.

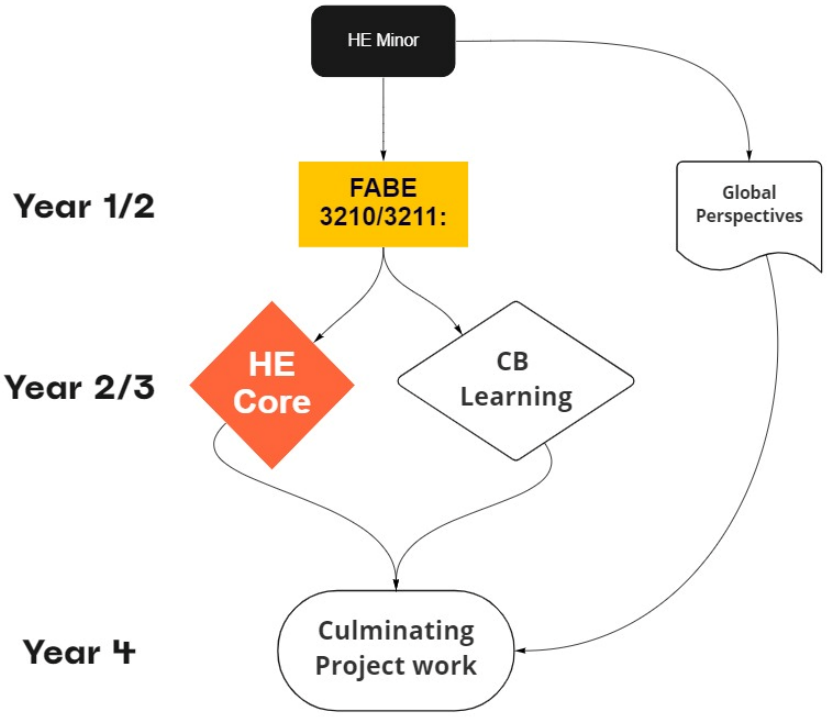

Figure 4: Student Pathway through the Humanitarian Engineering Minor

These elements of understanding stakeholders, and their values, paired with how those values and additional factors may create power dynamics were then compared and connected to current HE classroom practices and activities that a student may experience as part of completing the Humanitarian Engineering Minor. Each of the identified classroom activities are described below, as well as rated for intended student learning outcome via a simplified version of Blooms Taxonomy where U is for *Understanding*, A is for *analyze* and C is for *create* that corresponds to the intended practice in terms of student learning outcome.

COURSE 1: Introduction to Humanitarian Engineering FABE 3210

Reading and Reflection on Culture Activity:

Students read *Religion, Spirits, Human Agents and Healing: Conceptual Understanding from a Sociocultural Study of Tehuledere Community, Northeastern Ethiopia* - Explores the relationship among religion, spirits and healing and how it can inform healthcare. Students reflect on the paper and in-class discussion (Diversity of Stakeholder), (U)

Social Identity Wheel Activity:

Students self-reflect and fill out an identity wheel that has various physical, social and mental characteristics (Diversity of Stakeholders), (U)

Reading and Reflection on "ethno-engineering"

Students read *Indigenous Ways of Doing: Synthesizing Scholarly Literature on Ethno-Engineering* (Strobel 2013) to learn about indigenous practices as they relate to the Western notion of "engineering" (Stakeholder Dynamics) (U)

Reading and Reflection on Imperialism, Colonization and Decolonization

Students listen to multiple podcasts and read excerpts around these topics to draw connection to power and historical context. (Stakeholder Dynamics), (U)

Clock Exercise

Students have five individuals fill out a "Time Clock" of how they spend their day as well as completing it themselves. Student then analyze the responses for similarities and differences. (Diversity of Stakeholders) (A), (Stakeholder Dynamics), (U)

COURSE 2: Sustainable WaSH Infrastructure for Rural Communities CE 5610.01

Motivations Essay

Students read articles challenging motivations for community development and must write a reflective essay on their own motivations for being in the HE focused course. (Diversity of Stakeholders), (U)

Debate on International Development

Students are asked to prepare and deliver a debate on whether "we" Global North, should continue to pursue international development "global redistribution". Students have to defend their positions based on Communitarism, Libertarianism, Cosmopolitanism, and Moral Duty. (Diversity of Stakeholders) (A), (Stakeholder Dynamics), (U)

Appropriate Technology Exercise

Students work through a series of activities that provide case scenarios that challenge assumptions around planning and value of stakeholders. The activities start off with the concept of Shoes (something all students within the course are familiar with) and then transitions into WaSH technologies. (Diversity of Stakeholder, Power Dynamics), (A)

Case Study with Human Centered Design Lens

Students conduct a case study on an technology or practices related to WaSH. They research the technology and evaluate if the Human Center Design process was utilized and the effectiveness of the solutions for end users. (Diversity of Stakeholders), (A)

Community Development Project

Students work on semester long project where they conduct research on the historical context and cultural elements of the community they are "partnered" with. These are all hypothetical scenarios based on real communities that have been partners of OSU HE projects. Each project groups develops a hypothetical community development plan. –

Assignment sheet in Appendix (Diversity of Stakeholders), (A), (Stakeholder Dynamics), (A)

COURSE 3: Community Based Learning –Local, Travel, and/ or Collaborative Online Interaction Learning (COIL)– COIL

Origin of Name Activity, Who is… Activities

In the ice breaker tyle activities, students engage with each other and create various presentations about their own culture and the culture of their institution to share with the partner institution. (Diversity of Stakeholders), (U)

Developing a focus group protocol / Interview protocol

Students develop a focus group or interview protocol as part of a root cause assessment, this has traditional been around water access and water quality. Students must write the questions in English and native language as well as conduct multiple rounds of question reformation based on structured question of why they want the information. (Diversity of Stakeholders), (A)

Community Survey Analysis

Students review the results of a community survey to identified or understanding current conditions present within the community. (Diversity of Stakeholders), (A), (Stakeholder Dynamics), (U)

Cultural immersion (with community and institutional partners)

Students engage with local university instructors and students, community NGO members and community members throughout in-country trip/ communication prior. Multiple reflection sessions with students are held paired with journal reflections. This would also fall into Participant observation but less formal depending on the course. I.g. Student traveled to the river to collect water with community members. (Diversity of Stakeholders), (A) (Stakeholder Dynamics), (U)

COURSE 4: Global Perspective Course

Currently as structured within the minor the global perspective category is provided to allow students the opportunity to take courses focus on topics such as social/cultural, development/poverty, sustainability/environment, economics/international business/public policy and are meant to help engineers understand their users/clients and the context in which they live.

COURSE 5: Global Capstone - Culminating Project work

Hofstede Cultural Dimensions Activity

Students reflect on the Hofstefe cultural dimensions (Hofstefe 2011) for their own culture and then compare them to the country that there project is focused in. (Diversity of Stakeholders), (U) (Stakeholder Dynamics), (U)

IDI and GCC Modules

Students take the pre and post intercultural development index assessment within the class. They also work through the Global Competency Certificate modules. They write reflections on each of these elements (Diversity of Stakeholders), (U) (Stakeholder Dynamics), (U)

Alterative and PESTLE Analysis

Student conduct alternative analysis and Pestle analysis in respect to their projects with consideration given to stakeholders. (Diversity of Stakeholders), (A), (Stakeholder Dynamics), (U)

Calls with NGO partners

Students engage in multiple call with NGO partners to learn about the desired project outcomes and establish contextual settings (Diversity of Values), (A), (Stakeholder Dynamics), (U)

Capstone Project

Students work on their yearlong project. Projects are scope through conversations with NGO partners and community partners with the idea of addressing a technical challenge. Student work through the Human Center Design process and write a project report to deliver to partners. Transitioned from physical project implementation to long term relationships. (Diversity of Values), (C), (Stakeholder Dynamics), (C)