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Special Focus Issue:
*Mentoring for Success:
Best Practices to Support Our Students and Colleagues*

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The Holistic FUEL Program: A Renaissance Foundry-Designed Mentoring Approach for Underrepresented Populations in STEM

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This study highlights an undergraduate-mentored research experience called the Holistic Foundry Undergraduate Engaged Learners (FUEL) program that is guided by the Renaissance Foundry Model. The authors review literature related to co-mentoring and co-learning models, make connections between the Foundry-guided, Holistic FUEL applications and these models, and provide an inductive analysis of evaluative data collected about the program implementation. In their evaluation of the program, students highlighted the positive role of co-mentoring to achieve program goals and their appreciation for making better connections between research projects and implementation strategies. Insights and lessons learned are provided.

This study highlights an innovative, undergraduate-mentored research experience called the Holistic Foundry Undergraduate Engaged

Learners (FUEL) program that is guided by the Renaissance Foundry Model (hereafter, the Foundry). As part of the original design, the Holistic FUEL program was conceived as an opportunity to explore the value of non-traditional mentoring opportunities related to research-identity development at a Southeastern, rural, four-year, public university that recruits a high population of first-generation students and offers technology-infused undergraduate curricula. Furthermore, this program specifically recruited underrepresented student populations in Science, Technology, Engineering, and Mathematics (STEM) disciplines specific to the region served by the institution (for example, females in STEM, Hispanic/Latinx, first-generation, and low socioeconomic status/rural). Exploring non-traditional mentoring experiences for these underrepresented communities is important because, as Linn et al. (2015) contend, the way most traditional research programs engage students (both undergraduate and graduate) may be further solidifying STEM stereotypes that hinder student identification within the fields.

In recent years, postsecondary institutions have focused efforts to offer opportunities for engaging students from diverse backgrounds in learning and research activities through mentoring. Although these engagement opportunities have been expanded with the use of technology and other avenues, they have also been challenged by what Bunnell et al. (2021) consider unrealistic expectations related to traditional systems that are recycled to address the needs of a more diverse and inclusive population. However, the literature also indicates that the use of appropriate mentoring models has led to the greater engagement of underrepresented students in STEM. These models can include, but are not limited to, building inclusion through mutual participation and community engagement among mentor and mentee relationships (Mathrani & Cook-Sather, 2020), reinforcing of belonging and empowerment when entering the STEM field (Latin, 2022), and co-curriculum building to improve engagement and learning outcomes (Bunnell & Bernstein, 2014). Additionally, teacher-student collaborative approaches that allow for identifying mutually beneficial outcomes for learning and research initiatives have been among the most successful (Bunnell et al., 2021; Narayanan & Abbot, 2020).

Having students engage with an innovative mentoring program, like Holistic FUEL, that allows them to co-construct their own narrative surrounding their research identities may hold the potential to influence persistence in STEM and warrants further exploration (Oyanader et al., 2021; Womack et al., 2020, 2021). Thus, this contribution offers an

overview of an application of the Foundry to the Holistic FUEL program that is both described and supported by scholarship. We sought to answer the following question: In what ways did student experiences in the Holistic FUEL program reflect the co-learning mentoring process guided by the Foundry? We propose that such an application of the Foundry to the Holistic FUEL program can offer valuable insights for program development, especially regarding successful mentoring models for underrepresented students in STEM. After reviewing the scholarship and outlining the theoretical application of the Foundry to the design of the program, we offer an inductive analysis using a multitude of data representative of undergraduate students' mentoring experiences. Implications regarding the application of the Foundry as a mentoring approach in the Holistic FUEL program are highlighted and connected to the findings of this work.

The Renaissance Foundry: Infusing Co-Learning and Mentoring

Traditional mentoring models adopt an apprenticeship approach to learning, wherein students are tasked to adopt and assimilate certain practices into their professional environments (Hsieh & Nguyen, 2015; Ives & Castillo-Montoyo, 2020; van Ginkel et al., 2015). For underrepresented student populations, however, this type of assimilative approach to mentoring may be detrimental (Ives & Castillo-Montoyo, 2020; Linn et al., 2015). According to Salis Reyes and Nora (2012), underrepresented student populations

. . . tend to pursue a less rigorous high school curriculum, particularly in science and math (Choy, 2001); are likely to earn lower scores on college entrance exams (Schmidt, 2003); and tend to earn lower high school GPAs. (qtd. in Ward et al., 2012, pp. 6-7)

These characteristics, compounded by postsecondary challenges, in turn, lead to underrepresented students having ". . . lower educational aspirations than continuing-generation college students" (Salis Reyes & Nora, 2012, pp. 6-7). This issue is further exacerbated in the STEM disciplines, where academic norms and stereotypes may not align with the backgrounds or experiences of underrepresented student populations (Linn et al., 2015).

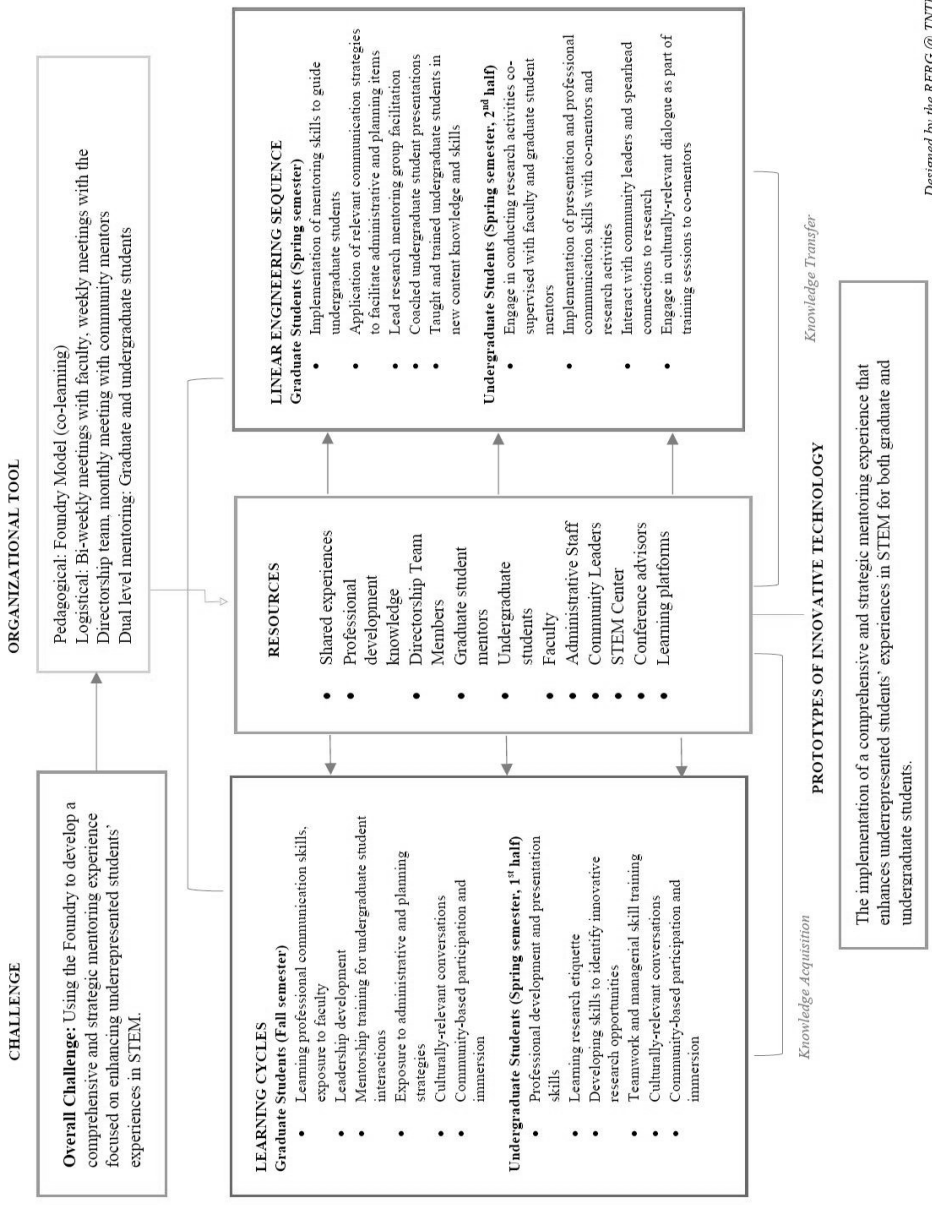
Thus, an important distinction with respect to more traditional approaches to mentoring is that the Foundry strives to eliminate

challenges related to traditional hierarchical structures among the participants by promoting the collaborative integration of different views of the practitioners. For example, in adopting a co-learning model, the integration of a Foundry-designed approach to mentoring can lead to a more inclusive environment where the students' voices become an important source of ideas for the solution of the challenge (Merk et al., 2013; Womack et al., 2020, 2021). Co-learning mentoring structures such as the Foundry can, therefore, lead to a fruitful generation of connections among concepts, models, and properties associated with innovation-driven learning, which is not typically associated with more traditional learning environments (Hsieh & Nguyen, 2015). For underrepresented student populations, these types of connections become pivotal in advancing their own notions of sense of belonging, self-efficacy, and overall notions of academic success (Ives & Castillo-Montoyo, 2020).

Figure 1 provides an overview of the major elements and paradigms on which the Foundry is anchored. A description of how the Foundry works in alignment with Figure 1 is provided in the section "Mechanisms of the Foundry: Guided Mentoring Aspects." The Foundry (Arce et al., 2015) is an innovation-driven learning system or pedagogical platform built on six elements organized under two paradigms: the *Knowledge Acquisition Paradigm* and the *Knowledge Transfer Paradigm*. These two paradigms offer a process-based template for the identification of a social or technological challenge and help to drive a path toward the development of a Prototype of Innovative Technology (PIT). The PIT is a student-team designed proposed solution to a complex, ill-structured challenge that is typically socially relevant and responsive to community needs. The Foundry works in a collaborative fashion among a team of students, researchers, or practitioners interested in innovative solutions to the challenge. This approach is uniquely suitable for mentoring students or colleagues in acquiring skills and knowledge via the learning cycles shown in Figure 1 so that these can be transferred (via the Linear Engineering Sequence [LES]). The approach of acquiring and transferring knowledge is guided by the effective use of organizational tools that are further supported by relevant resources that act as a central element within the Foundry (see Figure 1).

Among the pivotal resources leveraged in the Foundry are the facilitators of learning and the research mentors, both of whom interact with students and help implement the design. For the Holistic FUEL program this included faculty members, administrators, and graduate

Figure 1
Renaissance Foundry Model Applications to Holistic FUEL Mentoring Elements



Designed by the RFRG @ INTECH
www.Foundrymodel.com
Arce et al. 2020

students as mentors. The facilitators of learning and research mentors play an important role in helping the students or practitioners in navigating the various elements of the Foundry as a learning system, from the initial challenge to the development of the PIT (Arce et al., 2015; Arce-Trigatti et al., 2019). As a collaborative, student-centered approach to learning, the Foundry supports the relationship between the student and facilitator of learning as a co-learning type environment. Merk et al. (2013) describe a co-learning classroom as one that, “. . . is transformed into a vibrant learning laboratory that connects practice, research, and theory” (p. 13). Co-learning seeks holistically to understand and integrate students’ backgrounds and experiences without assigning characteristics that are non-congruent with traditional academic norms as deficits (for example, having no prior experience with research, a limited background in citation or academic writing, and the like) (Merk et al., 2013; van Ginkel, 2015).

Description of the Holistic FUEL Program

The Holistic FUEL program was a year-long effort implemented within the past five years and designed to contribute to positive outcomes in the recruitment, retention, and success of students in STEM from specific underrepresented populations being served by the institution. Given that a focus on mentoring through programming centered on inclusion and on guided research experiences, several seminars and workshops were offered. Further, student participants were assigned to research projects based on their declared interest. These included projects focused on topics related to socially impactful research applications, biomedical research, environmental (water/wastewater treatment) research, and agricultural applications.

The mentoring aspects of the Holistic FUEL program were implemented over the course of two semesters within an academic year that began in the fall and ended in the spring. A Foundry-guided design of the mentoring program infused immersive experiences that were both research-driven and implemented within a co-learning environment; these immersive experiences were intended to be mutually beneficial for both graduate mentors’ and undergraduate mentees’ outcomes. The Holistic FUEL program was founded with the intent to have student-to-faculty interactions as well as student-to-student interactions continually embedded throughout. The goal was to expose all student participants to various strategic opportunities—enhancing the mentoring practices of the graduate students and the mentored

experiences of the undergraduate students. This approach is distinct from traditional mentoring programs. The mechanics of the program are detailed below.

Mechanisms of the Foundry: Guided Mentoring Aspects

Figure 1 outlines the mentoring mechanisms of the Holistic FUEL program as they relate to the elements of the Foundry and the knowledge acquisition and knowledge transfer paradigms. During the fall term, graduate students were asked to join the directorship team as contributing members of the planning stage. The challenge of the Holistic FUEL program was to use the Foundry to develop a non-traditional mentoring experience designed for those intentionally recruited for the program. The recruitment process provided many opportunities for each of the graduate students to engage in the conception of a program that had not yet taken form, with the ability to co-lead alongside faculty members and engage in the knowledge acquisition, including planning, advertising, and recruiting for the program (see Figure 1). Additionally, each graduate student was able to participate as a co-leader but also receive the guidance and mentoring of the directorship team. The Foundry in this portion of the program played a major role in effective knowledge acquisition and desired outcomes of what Bunnell and Bernstein (2014) outline as “improving engagement and learning through sharing course design with students” (p. 5).

During the spring term, the mentoring duality transitioned from student-to-faculty relationships to student-to-student relationships. With the use of the pedagogical foundation provided by the Foundry, graduate students who had helped develop the program were able to implement their design toward student engagement in the knowledge transfer phase (see Figure 1). Both in and out of the classroom environment, the graduate students were provided with the opportunity to, for example, guide undergraduate students, apply relevant communication strategies, lead mentoring groups, coach undergraduate student presentations, and teach content knowledge skills (see Figure 1: Linear Engineering Sequence). The undergraduate students, in the midst of developing their research projects, were exposed to knowledge acquisition as part of the first half of their mentoring (see “Learning Cycles” in Figure 1, for example, professional development skills, research etiquette, teamwork skills, community immersion)

and to knowledge transfer in the second half (see “Linear Engineering Sequence” in Figure 1, for example, conducting research, implementation of research presentations, making leadership connections in the community). The co-creating and co-learning environment developed by the application of the Foundry further allowed the participants in the program (both faculty and students) opportunities to learn to navigate the challenges present in institutional norms and practices (Bovill et al., 2015).

Method

Analytical Strategy

The focus of this study was to better understand how the collaborative elements of the Foundry model became reflected in the mentoring opportunities experienced by student participants in the Holistic FUEL program. Specifically, we asked the following question: In what ways did students’ experiences in the Holistic FUEL program reflect the co-learning mentoring process guided by the Foundry? To address this question, we leveraged a general inductive approach to identify major patterns that captured the “frequent, dominant, or significant themes inherent in raw data” representative of various student experiences within the Holistic FUEL program (Thomas, 2006, p. 238). A general inductive approach has been described by scholars as a way to capture important, patterned responses within a dataset representative of specific experiences that are strongly linked to the data themselves (Ary et al., 2010; Thomas, 2006). According to Thomas (2006), the findings from an inductive analysis “result from multiple interpretations made from the raw data by the researchers who code the data,” and they are shaped by the assumptions, experiences, and decisions made by those most familiar with the dataset (p. 4). Because this study evaluated the mentoring experiences of students as they engaged in research activities in the Holistic FUEL program, using an inductive approach to data that captured their experiences from different parts of the program (for example, activities, one-on-one interactions, leadership meetings) was essential to making connections between how these experiences reflected Foundry-guided mentoring strategies.

Context

The Holistic FUEL program was implemented during the COVID-19 pandemic at a four-year, public university located in the Southeast-

ern United States. The program was funded by a state grant that focused on advancing the academic success and retention of underrepresented student populations in the region. The university is located in a region categorized by state authorities as economically depressed or distressed and serves primarily rural students with a growing first-generation student population. The directorship team for the Holistic FUEL program comprised seven individuals (including faculty, graduate students, and staff) in addition to five graduate student co-mentors that reflected a multiplicity of social and disciplinary intersections, including both gender and racial diversity. The initial cohort of 28 undergraduate students included 12 males and 16 females from various STEM disciplines across campus. All students identified as one or more of the recruited underrepresented student populations, including females in STEM, low socioeconomic status, rural, first-generation, or Hispanic-Latinx.

Data Collection

As part of the Holistic FUEL program, several metrics were used for data collection to evaluate and better understand undergraduate students' mentoring and research experiences. The metrics that were used to evaluate this program included disaggregated and de-identified student feedback surveys, focus-group measures, reflections, assignment activities, student projects, program publications and public relations documents, and meeting minutes. All forms of data that were selected featured students' voices, with quotations and snapshots of their experiences selected to be representative of the varied way in which mentoring could have manifested in the program (Fusch & Ness, 2015). In this way, the dataset was meant to be both comprehensive and reflective to achieve depth within the data (Fusch & Ness, 2015). Institutional Research Board (IRB) approval was sought and given for the purpose of this study; as part of the original parameters for compliance, the data were intentionally disaggregated and de-identified.

Data Analysis

Inductive analysis is often coupled with the inductive coding process, which is reflective of an iterative analytical approach based on close readings, familiarization, and analysis of the text and content featured in the dataset (Ary et al., 2010; Thomas, 2006). To begin the process, the authors became familiar with the data points initially as

part of data collection, but again in reading and re-reading the texts. From these readings, general categories were created and revised and then refined upon further iterations in the coding process, leveraging all data as potential sources for text-based analysis. Refining the categories resulted in three major themes: (1) Facets of Knowledge Construction in Mentoring Experiences, (2) Holistic Learning Elements, and (3) Value of Research Experiences. Table 1 provides an overview of these themes, their descriptions, and example codes.

Data Trustworthiness

Because inductive analysis is based on patterned responses found within the data, this analysis was guided by the interpretive categories created by the researchers in this process rather than by the research question itself (Ary et al., 2010; Thomas, 2006). For this type of analysis, the researchers leveraged prolonged engagement, persistent observation, and triangulation (through various data sources) as forms of building the trustworthiness of the analysis (Ary et al., 2010). Further, all authors are familiar with the Foundry model and helped to co-develop and co-create the curriculum for the Holistic FUEL program. Being active members of the Holistic FUEL directorship team, creating and implementing the curriculum, and participating in the data collection process allowed the researchers to have a nuanced and comprehensive understanding of the data as well as students' experiences within the program.

Limitations

As with all inductive studies, and therefore inherent in the design of this study, one limitation that can be identified is the transferability of the findings (Ary et al., 2010). This study was intended to explore the experiences of students enrolled in the Holistic FUEL program during one semester of data collection; due to the student population, unique context, Foundry-guided approach to the design, and specifics of the data collection, the findings are not easily representative of other contents. Future cross-case comparisons with other Foundry-guided programs or courses could offer more evidence of transferability with respect to the relevance of these findings as mentoring implications.

Findings

As previously noted, three major themes resulted from this analy-

sis: (1) Facets of Knowledge Construction in Mentoring Experiences, (2) Holistic Learning Elements, and (3) Value of Research Experiences (see Table 1).

Table 1 Theme Description and Overview		
<i>Theme</i>	<i>Description</i>	<i>Example Codes</i>
<i>Facets of Knowledge Construction in Mentoring Experiences</i>	This theme underscored student learning that occurred from specific knowledge construction (i.e., acquisition and/or transfer) processes that were Foundry-guided.	Gaining Applying Skills New Concepts New Ideas Learning
<i>Holistic Learning Elements</i>	This theme highlighted strategies related to holistic learning elements from the students' perspectives in the program wherein their personal backgrounds and past experiences were integrated as relevant resources.	Collaboration Teamwork Background Real World
<i>Value of Research Experiences</i>	This theme featured experiences that were indicative of students valuing research as part of their academic growth and professional career.	Connections Leadership Motivation

*Theme 1:**Facets of Knowledge Construction in Mentoring Experiences*

The first data theme, “Facets of Knowledge Construction in Mentoring Experiences,” is reflective of patterned responses from students that underscored the learning that occurred from specific knowledge construction (that is, acquisition and/or transfer) processes that were Foundry-guided. Throughout the Holistic FUEL program, students were exposed to Foundry elements as part of their training and asked to reflect on their own perceptions of themselves as researchers in tandem. In the analysis, coded data indicated students’ sense of connection between the knowledge acquisition and transfer processes inherent within the mentoring they received and their successes in research. For the researchers, these codes offered evidence of Foundry-guided knowledge construction processes that were taking place when students leveraged mentoring experiences to make meaningful connections in their learning within the program. For example, one student’s response to an assignment submitted for the program asking about their perception of research includes a focus on both gaining knowledge (acquisition) and creating knowledge (transfer):

The benefits of research are gaining knowledge, gaining various perspectives and outlooks, and increasing one’s experience in a topic of interest, which could be beneficial if they wish to pursue a career in that interest. It is always beneficial to gain knowledge, especially in fields one might encounter in their major and career. Knowledge is one thing that every student and individual strives to gain and never ceases to stop chasing.

In this response, the student expounds that research is integrally tied to “gaining various perspectives and outlooks,” which is a fundamental element of collaborative mentoring and the Linear Engineering Sequence in the Foundry (see Figure 1).

Another excerpt from a student reflection offered as part of the debriefing after a training session provided more detail on a similar connection:

[Research] will also introduce new ways of thinking; various perspectives to a problem can introduce new strategies to solve those issues. Gaining new perspectives, whether that be through the diversity of the team, or an interesting resource discovered through one’s research, makes one a stronger problem solver because they can combine perspectives to create the best possible solution.

This description further iterates the notion of knowledge acquisition (for example, “gaining new perspectives”) and transfer (for example, “combine perspective to create the best possible solution”) as part of the student’s research experiences in the program. Focusing on the benefits of “various perspectives,” “the diversity of the team,” or “an interesting resource” as ways to gain knowledge, problem solve, or learn are reflective not only of an inclusive type of mentoring environment but also of an appreciation of knowledge construction via connection-making as part of the student’s own development.

Theme 2: Holistic Learning Elements

The Foundry-guided approach to mentoring featured elements of holistic learning that embodied and integrated students’ personal backgrounds and experiences as valuable assets to engaging in research (Arce-Trigatti et al., 2021; Oyanader et al., 2021). As part of the second data theme, “Holistic Learning Experiences,” the data reflect patterns of elements related to holistic learning that were apparent in the data collected throughout the program. In this respect, connections between the Holistic FUEL mentoring and research experiences were made evident in the way students emphasized the type of learning that was fostered in this environment. This theme, therefore, highlights strategies related to holistic learning elements from the students’ perspectives and experiences in the program wherein their personal backgrounds and past experiences were integrated as relevant resources into their mentoring.

For example, as part of their training students were tasked with initiating various knowledge acquisition and knowledge transfer experiences to better assist them in the design of their prototype of innovative technology (Arce et al., 2015). In a Foundry-guided assignment from the program that asked students to explain this process, a student reflected on how the Foundry had helped them to integrate different voices into the process. In this response, the student explained, “Using the Foundry-Model we were able to have fruitful and thought-provoking conversation in the mere planning stages for what would become the next semester projects.” Within the same response, the student elaborated that this type of experience “gave me the opportunity to learn how to engage a large group of students into our weekly conversation.” These types of collaborative, “thought-provoking” experiences became relevant contributors to holistic learning opportunities that allowed for connections to be made between students collaborating on research projects.

Another student response from the focus group data touches on the importance of valuing personal backgrounds and experiences as part of the research process: “Benefits of research for me are a better understanding of what research truly is and how it is accomplished outside of the classroom, meaning practical application.” This type of practical application connects to the spaces in which students’ personal backgrounds and experiences can become valuable assets in the learning process, which, for this student, included connections to classroom content, personal experience, connections between peers, and real-world experience. From this excerpt, we gleaned that within the Foundry-guided mentoring structure of the Holistic FUEL program, students were indeed leveraging “outside of the classroom” experiences to make meaningful connections to what research meant to them, both personally and professionally.

Additional data from the Holistic FUEL program indicate how students’ self-efficacy as researchers and their ability to contribute to knowledge construction were related to the way they connected these qualities to their personal experiences or backgrounds. For example, a publication featuring a graduate student mentor’s experiences within the program elaborates on their exposure to different projects: “I was able to participate in numerous amounts of undergraduate research . . . all of those experiences led me to where I am today as a graduate student [mentor].” For this student, the personal connections made with previous research opportunities could be leveraged as part of the mentoring experience in Holistic FUEL, in turn role modeling to students how research can be a holistic endeavor integrating personal backgrounds and experiences as resources.

Theme 3: Value of Research Experiences

The third data theme, “Value of Research Experiences,” includes elements of the data that are reflective of the value of research for students as part of their co-learning mentoring experience. In reflecting on their experiences, students noted the value of research as part of their academic growth and made connections to how they envision its integration into their professional careers. In coding the data, it became apparent that this type of fluidity, where such connections between learning and real-world experiences can co-exist, were aligned with mentoring techniques related to co-learning (van Ginkel et al., 2015). Several of these codes were related to data relating students’ excitement associated with making these types of real-world connections and anticipating future research activities.

As part of the mentoring process in the Holistic FUEL program, students were exposed to a variety of ways in which research could manifest. In this sense, mentors were intentionally fostering the value of different frameworks for understanding and valuing research from diverse perspectives. In a student-led publication about the program, the projects that were created were described as “research that is both socially impactful and relevant.” This excerpt underscores the value that students placed on the connections that their research initiatives made to real world challenges.

Furthermore, in describing their excitement for experiencing research in different settings, students underscored the transferability of research and how it can be developed in different ways. In an open-ended survey response regarding intentions to stay in their major, for example, one student underscored the value of research as part of their motivation to conducting lab work. As this student explains, “I am looking forward to working in a lab, and I am looking forward to hopefully doing environmental research. I am looking forward to experiencing different research steps.”

Additionally, in a closed-ended survey question, 91% of respondents indicated that they either agreed or strongly agreed that research is valuable to their academic career. This was further supported by student debriefing reflections on how they were going to use their training and mentoring as part of their continual growth. One student indicated,

I look forward to experiencing how to research effectively, how to develop effective tests and theories, how to decide on proper equipment and learning the different equipment available to me, and experiencing all of the hard work [coming] together and [leading] to a significant development.

In this way, this reflection is making a connection between engaging in research as academically beneficial as well as a mechanism to advance work they believe is valuable.

Implications and Lessons Learned

Leveraging a Foundry-guided approach to mentoring held implications for the way student populations initially engaged in undergraduate research opportunities within the Holistic FUEL program. Based on the findings from this contribution, students’ experiences in the Holistic FUEL program reflect various aspects of the Foundry-guided co-learning mentoring processes embedded in the curriculum.

In considering the lessons learned from implementing the Holistic FUEL program, we focus on two major practices that changed the way in which mentoring occurred that are connected to students' experiences in the program: how Foundry-guided mentoring approaches were leveraged to facilitate knowledge construction and how the co-learning experiences with our students helped to enhance student participation and collaboration within the program.

Theme 1 in this study outlined ways in which the focus of the Foundry model as an innovation-driven learning platform assisted students in integrating knowledge from the co-learning experience as valuable knowledge-construction strategies. These findings tie into previous literature, which also supports how the Foundry model allows both the students and the facilitators of learning to contribute to both the knowledge acquisition and knowledge transfer paradigms in their search for a prototype of innovative technology (Arce et al., 2015; Womack et al., 2020, 2021). Because innovation is supported by open brainstorming, diverse ideation, and active collaboration, engaging in the Foundry necessitates that all collaborators contribute to the knowledge construction process (Arce-Trigatti et al., 2021; Womack et al., 2020, 2021). In terms of mentoring, this type of innovation-driven learning tasks students and their mentors to become active participants in the learning process, aligning with best practices in student-centered learning and mentoring supports, which, in turn, is reflective of the co-construction experiences represented by the data in this study.

As noted above, the mentoring approach used in the Holistic FUEL program was designed in a way that was reflective of the innovation-driven approaches affiliated with the Foundry (Arce et al., 2015). Such a design centers on collaborative, co-learning strategies that aim to transform what students may alternatively experience in traditional apprenticeship-style approaches to mentoring (Ives & Castillo-Montoya, 2020; van Ginkel et al., 2015). In using co-learning strategies within the Holistic FUEL program, for example, the Foundry model offered the facilitators of learning a platform to help students be exposed to diverse perspectives, make connections between them, and construct new interpretations that are representative of these interactions. These experiences were reflected in Themes 2 and 3 of this study, wherein students expressed the ways in which holistic learning elements allowed them to make connections between research and their learning practices as well as identify ways in which research was valuable for them, both personally and professionally, as part of their overall growth.

Concluding Remarks

This study centered on the application of the Foundry as a guided approach to mentoring within the Holistic FUEL program. As part of this work, the scholarship outlining the theoretical application of the Foundry was reviewed to provide a foundation of the design of the program. An inductive analysis was conducted on the evaluative dataset, which included a multitude of data reflective of students' experiences within the program. Based on the guiding question for this study, three major themes were identified as part of this evaluation: Facets of Knowledge Construction in Mentoring Experiences, Holistic Learning Elements, and Valuing Research Experiences. These themes help us to gain a deeper understanding of how the Foundry can be leveraged as a co-mentoring guiding framework that assists students to engage in a holistic-centered approach to fostering the integration of different perspectives into their learning.

As indicated, the data reflect student connections between their own backgrounds and the value of research with respect to the opportunities afforded in the program. Moreover, students were made aware of broader resources that allowed for creative thinking in how they approached complex problems presented in research as well as how they envisioned research. Thus, fueled by the Foundry, which provided avenues of mentoring that included the integration of different perspectives from mentoring and co-learning, students were able to reflect on connections made between research and learning strategies that expanded their own knowledge about the challenge and development of a prototype of innovative technology. Through this contribution, we explored how the Foundry could be a potentially suitable guide for the formation and implementation of co-learning mentoring strategies where collaboration between students and facilitators of learning can be leveraged.

Based on the findings of this study, potential avenues that would be beneficial to explore in the future include, for example, how students perceive their role in co-constructing a mutually beneficial learning environment where they can offer adjustments to the teaching/learning strategy proposed by the instructors. This could be complemented by investigating the type of approaches that can be implemented to facilitate student-faculty partnerships in curriculum construction that meaningfully incorporates students' voices. Expanding research into these areas will help us better understand how the Foundry can facilitate the development of efficient co-learning environments

where students' voices and instructors' points of view are effectively integrated.

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