

Engineering instructional faculty perceptions of students' background at Hispanic Serving Institutions

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Abstract— This work-in-progress research paper shares preliminary results from exploring faculty perceptions and beliefs about students' backgrounds in engineering at Hispanic Serving Institutions (HSIs). Faculty enhance or hinder learning through their interactions with students. Fostering an asset or supportive-based mindset in the classroom is crucial to supporting students' learning. As part of a larger multiple case study, preliminary results from a qualitative analysis of faculty interviews indicate that most faculty fostered a supportive-based mindset (e.g., intentional approaches to help students or alleviate challenges), an emergent theme regarding students' backgrounds, while others gravitated towards asset-based perspectives. Despite these findings, a few faculty members also expressed deficit-based mindsets. Therefore, this study seeks to enable the design of faculty development opportunities at HSIs informed by understanding faculty perspectives of their students' backgrounds.

Keywords—Perceptions, Epistemologies, Instructional Faculty, Engineering, Hispanic Serving Institutions

I. MOTIVATION AND BACKGROUND

Research indicates that student learning within engineering can be supported and enhanced when instructors take an asset-based approach [1],[2]. Consider this example of a faculty member observing a student with a full-time job. The faculty member could view it as an opportunity for their student to apply their learning from outside of class in the course, thereby framing the full-time job as an asset, i.e., an asset-based framing. Alternatively, they could see that job as a detriment to their student, thinking that the job takes too much time away from coursework, i.e., a deficit-based framing. Ultimately, how faculty frame student characteristics, backgrounds, and previous experiences can affect how faculty design learning environments and experiences [3].

For Latinx¹ students, faculty support is a crucial element contributing to retention in engineering [4]. Given the need within engineering to further support broadening participation efforts for Latinx students, this work-in-progress examines faculty support and perceptions at Hispanic-Serving Institutions² (HSIs), institutions that play a crucial role in educating Latinx engineering students. Currently, HSIs enroll 67% of Latinx students pursuing higher education, placing HSIs

in a position to significantly impact the education of Latinx students [5]. HSIs enhance the outcomes of Latinx students through student-centered support programs, inclusive curricula, and responsive admission and retention initiatives [6-9].

This paper focuses on a particular subset of faculty at HSIs, Engineering Instructional Faculty (EIF). Within engineering programs at HSIs, and engineering programs broadly, instructional faculty comprise 28% of faculty [10]. EIF predominantly fill teaching roles in both low- and high-level courses, with most teaching between 3-4 courses a semester [11], [12]. The teaching-focused nature of this position allows EIF to have increased levels of contact with their students, enabling them to support their students' learning and interact with the students more frequently. As a result, these instructors play an important role in students' academic success, particularly the academic success of Latinx students at HSIs.

Although EIF have frequent interactions with students and provide them with necessary support, it is essential to be mindful of the instructor-student relationship, a critical power dynamic in which the instructor has the upper hand and is often considered the source of all knowledge. In this unbalanced relationship, some scholars argue students' backgrounds have not been taken into consideration in educational settings [2],[3],[13]. Students' backgrounds, or epistemologies, include factors that contribute to an individual's holistic perspective, for instance, their socioeconomic status, family history, culture, or language. Bernal argues that, for too long, epistemologies of students of color have been constantly compared to a Eurocentric epistemological perspective [8]. As such, these comparisons may bring deficit-framing perceptions that students of color have more needs than other students [13].

Despite these findings, research also suggests that faculty can take tangible steps to adopt asset-based framing perceptions. For instance, asset-based perceptions could drive educational initiatives that align curriculum with culturally responsive teaching practices that leverage students' funds of knowledge with classroom content and assessments [2]. Additionally, faculty who diversify their teaching practices and student interaction methods are more likely to understand their students better, yielding better engagement and overall higher learning outcomes [14].

With this in mind, it is important to further understand EIFs' perceptions of their students' backgrounds and how their perceptions influence their teaching approaches. Therefore, we

seek to explore how EIF from HSIs perceive and approach students' backgrounds in their courses. Additionally, we hope to influence future faculty development opportunities to foster critical reflection that leads to faculty adopting practices that engage with students' backgrounds in the engineering classroom. In doing so, we could directly impact and increase the representation of underrepresented populations in engineering.

A. Theoretical Framework: Pedagogical Content Knowledge

This study is grounded in an adapted version of the pedagogical content knowledge (PCK) framework for science teaching [15]. This framework describes the intersection between an instructor's knowledge and beliefs about context, subject matter, and pedagogical practices. The authors adapted this framework to fit the engineering education context and to consider diversity more explicitly in the PCK component related to students' understanding of science. Originally, this component described the knowledge teachers have about how students develop scientific knowledge, for instance, the concepts students may find difficult in a course or the knowledge needed to learn a certain topic [16]. Fraser noted that PCK did not explicitly acknowledge the impact of student diversity in higher education settings in its original form [15]. Therefore, this component was extended to include knowledge and beliefs of students' backgrounds. The adapted component enables exploration of key aspects of inclusive and learner-centered instructional practices, specifically an understanding of one's students. This component captures asset- and deficit-based framings to explore how the instructor's knowledge and beliefs influence their teaching approach and interactions with students.

II. METHODS

As part of a larger multiple case study exploring EIF experiences at HSIs, interviews were conducted with 17 EIF at six different HSIs. Researchers de-identified, transcribed, and coded the interviews using a blend of deductive and inductive analysis approaches to answer the following research questions:

- (1) What perceptions do EIF hold about their students' backgrounds?
- (2) How do these perceptions influence their teaching practices?

A. Sites and Sample

This study was conducted at six HSIs from across the Southwest and Southeastern United States. An initial online search for HSIs with instructional or teaching-track faculty in engineering was undertaken to select the research sites. The institutions were separated by type: 1) public 4-year institutions, 2) private 4-year institutions, and 3) 2-year institutions. Two institutions were chosen for each institutional type from each region. A screening survey was then sent to faculty and administrators at the selected institutions and 17 engineering instructional faculty were recruited. Each institution was represented by one to four participants. In the screening survey, participants were asked a variety of demographic questions. Nine of our participants identified as women, five identified as men, and three preferred not to say. Additionally, two participants identified as Asian, one as Italian, eight as

Hispanic/Latinx, ten as White, Non-Latinx, and two preferred not to say. Of the 17 participants, ten have been teaching at HSIs for 0-5 years, five for 6-10 years, one for 11-15 years, and one for 16-20 years.

B. Data Collection

Semi-structured interviews were conducted with all participants. These 45 to 60-minute interviews focused on learning about participants and their experiences as instructional faculty members at their respective institutions. The interviews consisted of nine questions that asked participants to describe a day in their course and to discuss how they manage their classroom, work with students, and what strategies they use to help students succeed.

C. Data Analysis

Two of the authors coded the interviews in NVivo using a blend of deductive and inductive coding methods [17]. The interviews were initially coded with a codebook developed from the adapted version of the PCK theoretical framework. The inductive approach was conducted using a modified constant comparison method [18] enabling the two authors to capture additional themes related to participants' knowledge and beliefs about students' backgrounds. A constant comparison approach, commonly used in grounded theory or related methodology, provided us the opportunity to capture emerging themes through an iterative research, classification, and discussion process. Then the resulting emerging themes were examined further through consultation with the literature and with the rest of the authors who served as critical de-briefers. The asset- and deficit-based components were added to the analysis to understand how the instructor's knowledge and beliefs influence their teaching practices and interactions with students. The additional emergent themes in the data were entitled supportive-based perspectives and awareness.

III. LIMITATIONS

The results reported in this study should be considered with some limitations in mind. This study was conducted during the COVID-19 pandemic, waves of social unrest, and overall strenuous times. Understandably, faculty members needed to transition to digital platforms and make constant adjustments to their approach to curriculum development and delivery. Although the interviews asked instructors to reflect on their experience in their pre-pandemic classroom, some instructors also shared their experiences during the pandemic. Both were included in the analysis. These experiences may have shaped their perspectives. Lastly, interviews were conducted with a small number of faculty members; therefore, these results are not meant to be generalized, but elements may be transferable to similar contexts of EIF at HSIs.

IV. RESULTS

A. Overview

Preliminary results presented in Table 1 indicate that, of the 12 EIF who expressed knowledge of their students' backgrounds (N=17, n=12), their knowledge could be categorized into one of

four themes. Two of the themes encompass the asset (n=3) and deficit-based (n=4) perspectives of students' backgrounds mentioned previously. The others were emergent themes capturing supportive-based perspectives (n=7) and awareness (n=3). Overall, EIF most often reported supportive-based perspectives, illustrating instances where the EIF provided resources to help students be successful despite perceived negative external factors (e.g., recording lectures for those who could not attend class). This perspective is different from an asset-based approach which reframes the educational experience to be enhanced by the students' external factors. While some faculty did express asset-based perspectives (n=3), other instructors articulated an awareness of their students' diverse backgrounds but did not describe specific actions taken in response. Finally, some participants shared perspectives of what students could not or do not do from a deficit-based view. To avoid further propagating deficit-based views of Latinx and other HSI students, the results focus on the supportive-, asset-, and awareness-based perceptions of faculty. At the same time, we acknowledge the need as researchers and educators to continue to 1) work with faculty to reframe deficit-based views and consider their students' strengths and 2) critically examine and intentionally act against systems that remain unresponsive to students' needs and perpetuate their marginalization [19].

TABLE I. FREQUENCY ANALYSIS

Category	Number of Participants per Category	Total Number Statements per Category
Knowledge and beliefs about students' backgrounds	12	29
Asset-based	3	4
Awareness	3	3
Deficit-based	4	9
Supportive based	7	13

B. Awareness-Based Framing

Of the 12 participants that expressed their knowledge and beliefs about their students' backgrounds, three spoke of their awareness of their students' backgrounds, meaning they acknowledged their students' context and environment but did not hold a specific perspective or take action. In this category, participants realized that their students have employment responsibilities, noticed students' unstable internet connections, or simply acknowledged that their student population came from a lower economic status. For example, one participant recognized that some students may not have access to technology:

"The other issue we had is ... and my institution did try to help, a lot of students didn't have personal computers, or they were sharing it with their family. It became an issue because, yes, we have class at 6:00. They know they have class at 6:00, but maybe they don't have the internet."

In this example, the participant expressed knowledge of a student's possible lack of resources, such as students not having

personal computers or internet, and acknowledged that could prevent them from attending class online at the time it was scheduled. But no clear response, action taken, or judgment was evident. It is important to note that all 12 participants were aware of their students' backgrounds; however, three of them only expressed awareness of students' backgrounds and did not express any supportive-, asset-, or deficit-based framing.

C. Supportive-Based Framing

Most participants (n=7) described supportive-based framings regarding their students' backgrounds. Of these participants, many expressed supporting students through their education by providing equal access to resources and financial help. For example, participants indicated that they provided ways for students to access course content and material outside of class time to continue supporting their learning. One participant, for example, described their efforts around financial support in the following manner:

"... one of our students and they were on [FAFSA] and everything else. And they came up and they had spent almost \$2,000 on textbooks, more than their tuition. And I just about flipped out. [...] So, I said that that's it. We are using [free] open-source material online. This is ridiculous."

Here the instructor recognized that spending nearly \$2000 on textbooks was "ridiculous" and decided to change their course material to "free open-source material" that could be found online, in turn providing students with a lightened financial load. This type of financial support could be seen in other participants' responses, including creating scholarships to cover tuition costs for students and funding for projects.

Another participant, for example, described their efforts to provide students with course material outside of class:

"A lot of students now, they're like, 'My boss wants me to work from 9:00 to 5:00 because I don't have classes in person anymore.' So they go work from 9:00 to 5:00, and they watch lectures after the fact. So even though the class is synchronous, I make my lectures available outside of class. Some people don't, but I do, because I feel like it's unfair to students given the situation that if they have to work full time, if they have to make a living, they should be able to see the lecture outside of class."

Particularly in the case of the COVID pandemic, the instructors recognized that their students may have full-time jobs to attend, making it hard for them to attend the "synchronous" online classes and decided to make their lectures available outside of class to continue supporting their students' educations.

D. Asset-Based Framing

Lastly, as mentioned, a few participants (n=3) took an explicitly asset-based framing regarding their students' backgrounds, particularly in how they believe a student's background helps them succeed in the courses the students are taking. For instance, one EIF describes their students' backgrounds as a "great thing" that let them "get experience from many different aspects of engineering." Others

purposefully try to understand their students' educational background in order to "make changes that will make the learning experience more authentic."

V. DISCUSSION AND IMPLICATIONS

Overall, this qualitative study sought to explore the perceptions of engineering instructional faculty members at HSIs, particularly as it relates to their knowledge and beliefs about their students' backgrounds and their ability to engage in educational innovation and, ultimately, to design learning experiences that are inclusive and student-centered.

The analysis of interviews with 17 EIF from varying HSI contexts demonstrated specific perceptions of their students' backgrounds. Of the 17 participants, 12 EIFs acknowledged their students' epistemologies. Eight of these EIF implemented supportive practices within their courses based on their awareness of their students' backgrounds and current situations. However, some faculty (n=4) expressed a deficit-based framing of their students' backgrounds. Research suggests deficit-based framings can negatively affect students' educational experience in the classroom and their academic outcomes [3]. Despite the low frequency of asset-based perceptions (n=3), participants that adopted asset-based framings expressed a deeper understanding of their students' backgrounds and the actions that could be taken to leverage their backgrounds to enhance their learning. Additionally, participants that adopted supportive-based framing also expressed a deeper understanding of their students' background, however, rather than describing actions that leverage their students' backgrounds, they described actions that supported their students. These perceptions contrast with those that adopted deficit-based framings, which were somewhat superficial and subjective sentiments.

The teaching practices of EIF that expressed asset-, supportive-, or deficit-based framings regarding their students' background were influenced by their perceptions of their students' backgrounds. For those EIF that only expressed awareness of their students' backgrounds, there were no specific changes to teaching practices. For those expressing asset- or supportive-based framings, they modified their instructional practices in a variety of ways, including using free open-source material to make the course more affordable for students, recording lectures and making them available for students who cannot attend class, and providing PowerPoints slides to guide students through textbook readings.

This work-in-progress complements existing literature on asset- and deficit-based framings, particularly related to understanding the framings that instructors at HSIs adopt within their classroom [1]. This work-in-progress also extends existing work by providing a novel supportive-based framings that instructors hold regarding their students' backgrounds. Understanding the framings instructors adopt is crucial in designing faculty development opportunities at HSIs that could foster critical reflection on instructors' beliefs and practices related to their students' backgrounds. Additionally, there are opportunities to help instructors learn how to adopt asset and supportive-based approaches that leverage their students' backgrounds via inclusive and culturally responsive approaches [8]. Examples of these approaches include culturally responsive

techniques (e.g., intentional practices to know students, relevant methodology usage, activities involving family and community) that yield higher engagement and positive learning outcomes [10].

VI. CONCLUSION AND FUTURE WORKS

With the growing Latinx student populations at HSIs, specifically within engineering programs, these institutions must consider their students' unique backgrounds. Research suggests that students have funds of knowledge from their households, workplace, and other personal and professional experiences relevant to engineering [2]. These experiences are valid and can be leveraged by faculty members through various supportive and asset-based approaches. With the results of this work-in-progress and the larger study, we hope to design engineering instructional faculty development opportunities at HSIs to foster critical reflection, leading to faculty adopting positive and culturally responsive approaches to engineering course design.

AUTHOR'S NOTES

¹The term Latinx is used as a gender-neutral and inclusive term for people who identify as being part of the Latina/o community.

² The term HSIs is a federal designation given to institutions of higher education whose total full-time Hispanic enrollment represents at least 25% of the total enrollment.

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