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There Is No House Like the House of Belonging: Identifying Constructs of Belonging That Are Important to First-Year Engineering Students

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Introduction

Engineering in the United States is growing stagnant from a lack of change. According to Engineering by the Numbers for the year 2021, many of the top-producing universities for engineers either remained the same from the previous year or, in the case of George Tech (the top school), graduated fewer students in 2021 than in 2020 [1]. Much of the conversation surrounding engineering today is much the same as it has been for years. There is not enough "supply," i.e., engineers, to meet the demand for engineers in today's economy [2],[3]. Many have proposed that diversifying engineering can change this narrative and meet the demand for engineers [2],[3].

Much of the literature surrounding engineering diversification begins with these points as to why diversifying engineering is essential. But suppose this work was to follow the same path as much of the literature does on this topic. In that case, I fear the real reason and passion behind the work would be lost, along with the issue that repeating the same thing and expecting a different result is, by definition, insane. Therefore, to situate this work, where engineering diversification is crucial, the passion for doing so does not always need to come from wanting to help meet the "demand" for engineers. This work was conducted to help eliminate the barriers to engineering and higher education by investigating how to care for and retain the engineers we are trying to recruit for engineering. Because diversifying engineering is more than just recruiting students of diverse backgrounds to diversify the engineering population [3],[4],[5], the retention of these students is found to be just as important as recruiting diverse students [3],[4],[5]. Therefore, the scope of this paper focuses on sense of belonging which has been identified by many throughout higher education as one of the leading factors contributing to student retention [6],[7],[4],[5]. In conjunction with the observation that much of the attrition experienced in engineering programs occurs within the program's first two years [8]. Leads to the research question for this study:

> What do students in their first two years of engineering reveal as the most significant factors contributing to their sense of belonging in/to engineering?

Literature Review

Maslow identified belonging in the 1950s as a basic human need in the hierarchy of needs [9]. This belief would later be expanded upon by Baumeister and Larry in the 1990s when they adopted the view that belonging was independent of other social behaviors, such as influence or support, and described it as the perceived experience of consistent interactions and care from others [10],[9],[7]. Although in both cases, it was agreed upon that belonging is a basic human need and must be met for humans to move on and spend "resources" on higher-order wants. This means things like learning and understanding the world around us would not be prioritized before belonging. Thus, belonging must exist for an individual to have the desire to gain knowledge or learn [6]. Therefore the concept of belonging has recently been studied more and more as to what degree or significance it plays in students learning [11],[6],[7]. Its

importance was observed at the K12 level for some time with its influence on psychological and academic outcomes [6],[7].
Although when trying to translate what is being done on the K12 level to postsecondary, it has proven difficult for researchers to agree on how to accurately measure this psychological phenomenon [6]. Much of the most recent prominent literature examining undergraduate students and engineers has been done through theoretical modeling and quantitative instrumentation. Reminiscent of a top-down approach where belonging is being predefined/modeled and then applied.

Sense of belonging has recently been applied more and more to the engineering side of education as well, with many citing it as a potential avenue to retain minorities in STEM fields [4],[5],[6],[7],[12],[13]. Chang et al. [14] identified significant factors in retaining underrepresented minorities in STEM and found that belonging is one of the most important factors within the first years of college. Pointing to the fact that belonging can play a key role in whether students decide to stay or go, many in the engineering education space began to explore the nuance. Rodriguez and Blaney [4],[5] investigated how sense of belonging was affected for Latina students in STEM and found that the male-dominated environment of STEM and the marginalization as a product of that severely affected their sense of belonging. These findings were echoed by Allen [13] and Rainey et al. [5], who found that students from underrepresented groups have a significantly lower sense of belonging than their peers. The importance of sense of belonging cannot be understated in the retention of students and underrepresented students in STEM, but in addition to this, it is important to acknowledge that much of the literature examining sense of belonging is done from a predefined lens. Meaning that even in the recent studies that incorporate qualitative research methods, they are using the sense of belonging as a predefined theory and explain through its constructs how students do not have belonging. With this study, I will explore how to build upon a sense of belonging and see what is not being captured by the already-developed models.

Theoretical Framework

The theory guiding this work was composed of two main elements. One was the traditional theory of belonging, which we commonly refer to as a sense of belonging. Although Maslow was the first to establish the importance of belonging, Tinto is regarded as the originator of the theory itself [6],[7]. As Tinto's model naturally stands, it explains the concept of belonging as a component of social integration [6],[7]. Tinto's theory of belonging was then expanded upon by authors such as Baumeister and Leary, who contextualized it further and pushed for belonging to be its own independent construct [10],[7]. This then opened the door for educational researchers to test for belonging rather than see it as a by-product of social interaction. Much of the way sense of belonging has been defined and applied is through a top-down approach. Where constructs of belonging are universally applied as previously defined and the buckets already created. This lends itself well to a quantitative approach, which many of these researchers employed, but this paper's focus is to approach a sense of belonging from a bottom-up approach. This will be to attempt to capture what is salient from the student's perspective and how they define a sense of belonging using a qualitative approach. Therefore, the theory of sense of belonging will be used more as a benchmark to see if what comes forth

from the students' definitions fit in the predefined buckets or if they are describing types of belonging that the theory has not yet captured.

The other is a conceptual framework that identifies how the construct of belonging may be applied/has been applied throughout higher education and engineering research. Lee et al. [11] explored how belonging has been studied and researched throughout engineering education. They identified four main constructs or facets of belonging academic, social, general, and institutional [11]. Academic is the belonging a student feels from being successful or being recognized as successful in their course work [11]. Social is a student's perceived acceptance from peers and personal interactions [11]. General is the extent to which students feel accepted as their authentic selves [11]. Lastly, institutional is the perceived support to students by the institution [11]. These constructs were used in two main ways: the development of the interview questions and the other a tool for analysis. With the development of the interview questions, these constructs were used as a guide to ensure that we were asking questions that covered all currently known realms of belonging. As for the analysis, these constructs were used as the deductive codes for the code book.

Methods

The purpose of this study was to identify what constructs of belonging were identified by engineering students as being important to them, along with the goal of centering students' experiences in engineering regarding belonging. Therefore, an interview-based qualitative analysis was used to ensure the nuance of the student's experiences was not lost. The cases were all first-year engineering students that have just started their engineering programs at an R1 university in the southwest.

Positionality

I am a Hispanic engineer that comes from a family of engineers and educators. Growing up around both engineers and educators let me see the power and benefit it can have on one's life. Witnessing firsthand how education completely changed my family from migrant farm workers to engineers let me see how education is the power to control one's fate. Leading me to my belief that education is not only a right but the power to take hold of one's fate. This belief is a deep-rooted passion of mine and is the main motivator for my research. However, I must admit that this passion gives me a somewhat critical eye regarding higher education and how "prestigious"/out of reach it has become. I am aware of this criticality and actively work to not let this bias come through. For it is not my intention for fellow researchers to see me as someone who uses research to confirm my own belief but as a fellow researcher who brings research, just as important as others, to the table. My passion is also to eliminate barriers to higher education and engineering; therefore, this research is of personal interest to me. This passion is a way to build a rapport with the participants and create a space where I am "on their team" rather than an outsider analyzing them. Again, I am aware that my passion may persuade me, given how close my passion aligns with this research, but I would argue that the same passion that may bias my work would also help me make it the best work possible.

Participants

The participants selected for this research had to be within the first two years of their engineering programs. The year in the program was determined by credits and not by the physical year of the program, given the nature of higher education. All participants had to be enrolled in a university and over the age of 18. Three participants were used for this study, all identifying as white (race), one male, one female, and one non-binary. Participants were allowed to select pseudonyms, and Table 1 displays all the participants and pertinent demographic information.

Table 1. Participant names and demographic information.

Pseudonym	Race/Ethnicity	Gender	Year in school
Anom	White	Male	1
Chad	White/Russian	Female	1
Lee	White	Non-Binary	1

Recruitment Process

A recruitment email was sent to engineering students at a Southwest United States university, informing them of the inclusion criteria and about the study itself. They were told they would be compensated for an hour-long interview about a sense of belonging in engineering. Multiple were randomly selected from those who emailed back with interest in the study. Three participants were selected as the contrast between their narratives provided an extremely rich and nuanced comparison. It should also be noted that we could only complete three interviews at the time of dissemination.

Data collection

All participants underwent an hour-long semi-structured interview that was virtual. The software used was ZOOM, and interviews were video and audio recorded. Consent was ascertained a second time before beginning the interview or recording. The semi-structured interview questions were adhered to for consistency throughout each interview. However, questions outside the script were permitted to gain further clarification or allow space for the participants to elaborate on comments made.

The interview protocol contained questions addressing sense of belonging. The interview began by establishing how the participant conceptualizes belonging with questions like *What does belonging mean to you?* And *What aspects of your academic experiences make you feel belonging as an engineer? Can you tell me a time when you felt like you belonged as an engineer in your academic environment?* These questions could then be followed up on to explore experiences shared or comments made. The interview then shifted to exploring belonging in the engineering realm with questions like *How do you believe your experience entering the class compares to that of your peers?* And *What are some ways your professors have promoted belonging for all students in their classrooms?*

Data Analysis

The data was analyzed using both deductive and inductive coding. The software used to perform the coding was Dedoose. Specifically, the deductive codes were the sense of belonging constructs; academic, social, institutional, and general belonging, along with the lack of belonging, and the inductive code defining engineering. Given the study's scope, we wanted to

center the student's experiences and allow them to identify what was important to them about belonging. Therefore *In-vivo* coding was performed to allow for codes to come from the data that the deductive code may not capture for belonging. Each participant's narrative was coded with the codebook containing deductive and inductive codes. For the analysis presented here, we focused on the excerpts associated with each code that were exported and analyzed in excel. Using excel to organize the excerpts, a thematic analysis was performed to identify underlining themes between and within the codes. See the appendix for the complete code book and operational definitions of all codes. Interrater reliability was employed on the deductive code lack of belonging to ensure the coding was done in a nonbiased manner. We also employed peer checking, where we presented the themes and codes with the goal of catching any biases that may come through, as well as the cohesiveness of the study.

Findings

Upon conducting the thematic analysis, our team identified two main themes prevalent throughout the data the "mold" of an engineer and "Generational" Belonging. These themes were demonstrated across multiple codes and, in fact, were found to be common threads shared connecting the cases.

The "Mold" of an Engineer

One of the most prevalent findings was the acute awareness that engineering has a mold and how well one fits the mold. This became especially prevalent and important when speaking to how much it can make some feel as though they belong in engineering instead of how much they do not. It was seen that even without prompting the students, they could picture what engineering is and seemingly, in their mind's eye, see how they fit within that picture. For those who felt that they fit the engineering mold, an uncanny confidence came through when they would define what engineering is and how they saw themselves in engineering. The opposite was found for those who did not fit the mold or believed themselves not to.

> "Um, the reason why I wanna become an engineer, um, just basically be able to use creativity towards exploration where I can actually feel like I'm actually using my mind and my creativity. Not just sitting down, doing office work being a robot, you know, I just wanna basically be part of the future. Just like, uh, Okay. I'll just say, just my personal thing. Um, I just feel like it's part of the future where, you know, intelligent minds, like, um, I'll just say Elon Musk was one of my personal inspirations. Where, you know, a great person just comes out and just amazing things with an intellectual mind and inspires so many people to pave a pathway towards a great future for everybody. And that's why I wanted to become an engineer." - Anom

Here Anom is describing engineering, but the way he is describing it, you can see that he has a picture in his mind of what an engineer is as he describes it. Although his description is unique, as he describes engineering, he is not doing it from an outsider's perspective. He describes it like he is already a part of these ranks (or that he will be there soon). The picture is so clear for him that throughout his definition and defining engineering, we never see him falter

in his belief that he may not be able to live up to what he sees an engineer as. In fact, as he describes engineering as full of those with "intelligent minds," we see that he counts himself among those with the potential to join them. Demonstrating that on a subconscious level, he counts himself among those that fit the mold, and because of that, we see an immense boost to belonging and confidence that he can become an engineer. This is directly contrasted with how our female participant Chad feels about the mold. When prompted to reflect on what she would change in engineering to make herself feel like she was more welcome in engineering, this was her response.

> "Uh, I feel like there's like a stigma. A stigma around engineering. Like, oh, you have to be really smart, you have to know people and like there's kind of just like a floating thing around it. I would just change like the approach to it. Make it more like welcoming in a way. I don't know." - Chad

Chad speaks directly about how she feels like a stigma surrounds engineering. Even though she uses the word stigma, by the way, she describes it, she feels it is more than just that. When she describes engineering as having something "floating around it" that makes it unwelcoming, she indirectly points to the feeling that the mold gives students who do not "fit in." She repeatedly comes back to this point through the remainder of the interview calling it by different names but always reflecting on how it makes her feel or where it's coming from. Demonstrating that even though she could not explicitly call out that there is a mold in engineering, she felt its presence implicitly. She knew that something was telling her that she was "not like the others" and that it made her feel like she did not belong in engineering. Therefore, it is important to acknowledge that there is a mold in engineering and that students are acutely aware of it to the point that it can positively and negatively affect their sense of belonging.

"Generational" Belonging

One of the most significant findings was that in addition to traditional constructs of belonging, there was an underlying current hinted at but never explicitly named that gave students an incredibly strong sense of belonging. What I am referring to is the historical or temporal aspect of belonging. Many of the traditional constructs are acute or snapshots of what belonging is at that moment in time. But what became clear through the interviews was that many of these students felt they belonged long before beginning their higher education journey, even though they had just begun their engineering career. This was especially prevalent in the traditional engineering students, i.e. (white males) and was clearly contrasted when looking at those traditionally minoritized. When Chad was asked to reflect on her engineering journey so far, she began by describing.

> "I have my first semester of classes, which none are really heavy set in engineering yet. And so we're kind of just going through the basics of what it is, what it means to be and like what you can do with it. I just feel like I don't have a total understanding of it still though." – Chad

Although when I asked her to clarify or describe to me what she meant by not having a complete understanding, she clarified.

> "I just, it's more of the engineering part of it. Like, I don't know as like a career what it would entail for me to do. Or if there's a lot of different things I can do. And then also I just feel like no one really, I feel like almost behind in a way cuz a lot of people are like, Oh my parents are engineers or like, stuff like that. And like I never really got the basics of it, like, from high school or anything. So it's kind of like jumping into something I don't really know." – Chad

Here Chad is describing how engineering is something foreign to her and how, up until this point, she hasn't had any real exposure to engineering. Making it so that engineering almost feels alien. But even more important, when she says, "I feel almost behind," even though she's only a freshman in engineering demonstrates that the lack of generational belonging can cause students to feel like they are starting off at a disadvantage, further solidifying the feeling of not belonging. Exposing that generational belonging also started long before she stepped foot in an engineering classroom. Showing that as a freshman, she already feels as though she does not belong, given how little she knows about engineering compared to her peers. Interestingly enough, she is not addressing technical knowledge in this quote but actually just the knowledge of what an engineer is and does. This means that generational belonging goes beyond just that of technical know-how but also the knowledge of the profession or trade as well.

> "so I just feel like one of the restrictive components is just how much you have to know before you really get involved in engineering."

Anom as a white man, can reflect briefly on why he feels like engineering may be inaccessible. During the interview, when this was brought up, the only reason he was able to come to this conclusion was having to objectively look at engineering by taking himself out of the equation to come to this conclusion. Demonstrating that he had to remove his privilege to see the struggles others may have. Showing just how powerful generational belonging is, Anom, who has had exposure to engineering far before his higher education journey, already feels like he belongs to engineering strongly enough that he must objectively view it to see how others may struggle. In addition to Anom, Lee also a white student, when asked to reflect if they could think of an instance in which they ever felt like they did not belong to engineering.

> "Uh, personally, no. Just, yeah, simply, no, I don't think I've really had any feelings like that whatsoever."

In this excerpt, we can see that when prompted to reflect on a time when they felt they did not belong, Lee cannot picture or recall ever feeling as though they do not belong. It is particularly powerful because this sentiment is reflected multiple times throughout the interview. Throughout their interview, Lee described being highly exposed to STEM throughout their high school career, to the extent that they had teachers encouraging them to look into engineering as a career pathway. We can see that the presence of generational belonging gives Lee and Anom this incredible sense of belonging and confidence to the extent that belonging is not something at the

forefront of their minds or even considered. Demonstrating just how significant of a piece time has on belonging.

Discussion and Implications

Student retention is a large problem faced by engineering programs in the United States [6],[2],[4],[7]. Recently sense of belonging has been seen as an influential piece for student retention and the importance it places in keeping students [11]. This study demonstrates the importance of highlighting the students' perspectives and experiences when it comes to belonging to engineering. As we see reflected in the themes, significant aspects of belonging have been left uncovered or undiscovered due to the reliance on the traditional sense of belonging theories. The students' perspective can highlight the complexity of belonging and how factors usually not considered part of belonging can play a significant role. This study also demonstrates how aspects outside the bounds of belonging play a significant role in a student's sense of belonging.

The first finding highlights this phenomenon where the "mold" of what an engineer should be can severely affect a student's belonging to engineering. However, the mold itself is not necessarily captured within the predefined buckets of belonging. An argument can be made that the fallout of this phenomenon is captured with the traditional constructs of belonging like social and academic belonging, but I believe our finding demonstrates that these constructs would simply be capturing the symptoms that the mold causes, not the cause itself, therefore when trying to define the mold phenomena we would be limited to describing it through these traditional lenses rather than being able to speak to the phenomena itself. A perfect example of this is the uncanny confidence that participants displayed when they felt that they fit the mold of engineering and how this confidence can be captured as a student feeling socially accepted as an engineer. However, when defining it as such, we have lost what is causing the confidence and instead are focused on the fact that it is there. By doing so, we may never have seen that as much as the mold has helped a student like Anom, it has done the complete opposite to a student like Chad. Demonstrating the importance of having students define the aspects of belonging as much as having a model of belonging.

The Mold of Engineering

When Anom describes engineering and sees himself as a part of the mold, we begin to see just how powerful the mold is. As we pointed out before, he is painting a picture of engineering, and while painting, he does not see himself as an outsider, and more importantly, it's because there is no *reason* to see himself as an outsider. There lies the power of the mold. Engineering students who can subconsciously recognize that they fit the mold have no reason to believe that they will not be successful or welcomed by engineering. Whereas this is in complete contrast with Chad and how she actively feels uncomfortable or out of place because of the mold. Even more striking is that she is very aware of the mold because of its influence on her belonging. Demonstrating that in a situation where a student fits the mold, they are barely/blissfully unaware of its presence, whereas, for someone who does not fit, it becomes a very real presence in engineering. The mold's influence on students belonging can be extremely powerful in both a positive and negative sense. Therefore, the engineering community should begin to change and shape the mold.

I am under no illusion that the mold will disappear, but what I do believe could happen is that we can begin to redefine what the mold is and who is encompassed by it. Thereby being able to give all students that enter engineering a chance to benefit from the positive force it can be when

they fit the mold. Possible ways to begin changing the mold would be to "rebrand" engineering and redefine what engineering is, starting at the K12 level but continuing this messaging throughout engineering. Given that much of the messaging efforts are focused on before engineering, we need to strive to begin using some of that same messaging in engineering classrooms at the higher education level. Along with the rebranding, we need to explicitly name the mold, essentially outing it in the community. Much like a positionality statement in a qualitative research paper, it is time that the engineering recognizes its biases and makes those explicit to those trying to join. I think that the transparency of what engineering was/is and how we are trying to change it would go a long way with those trying to enter engineering. I do not believe that engineering can change as long as we are trying to acknowledge the problem but not completely acknowledge it at the same time. Trying to fix the problem before defining it so we can pretend it never existed is just bad engineering practice.

Generational Belonging

One of the most significant findings of this paper was the temporal piece of belonging, aka generational belonging. Overlooked by the theoretical constructs of belonging, this was a piece shared by each of the participants. Its effect on belonging was significant enough to make those just starting engineering either feel like they did or did not belong. As seen in the participant's stories, we can see that this facet of belonging could potentially be strong enough that a person can feel like they belong in the absence of the other constructs of belonging. We see just how potent this type of belonging is when both Anom and Lee are able to not only feel like they belong in engineering but feel it so much so that they begin to have an air of arrogance about them. This is extremely surprising, given that both are first-year students barely beginning their engineering classes. Demonstrating that these two have already begun to develop an engineering identity and belonging to engineering long before they even saw an engineering classroom. Chad, on the other hand, is completely lost and can almost sense that she is lacking something when comparing herself to her peers. Recognizing that she does not share that same confidence and, therefore, must be lacking something.

This early development of belonging exists outside the traditional constructs of belonging, given that many of them look at students' belonging as a moment in time. For example, when using a construct like social belonging, we do so by looking at how that student feels they belong in terms of the social environment at that moment. We are not accounting for the heuristical data or events that may have led to them feeling like they do or do not belong. Generational belonging shows that these students, who have no viable reason according to the traditional constructs of belonging to feel like they belong to engineering, have incredibly strong and secure feelings of belonging to engineering. Much like the mold, I believe generational belonging can be exploited for good, and the key to doing comes directly from the participants themselves. In both Lee's and Anom's accounts, we see how through multiple events leading up to higher education, they began believing themselves to be engineers and could visualize it, which in turn provided a strong foundation of belonging. Meaning that if we, as the engineering community, can begin fostering these experiences in students from an early point in their engineering journeys, we can potentially combat the lack of belonging that many minoritized students feel when they enter engineering. If we begin to foster their engineering experiences at the K12 level starting as soon as possible, we can provide these students with a sense of belonging to engineering so strong that, once in higher education have a chance to find other forms of belonging to supplement that one. It can be as small as a teacher saying, "you should consider engineering," as in the case of Lee or Anom, which can

start a student on a path to engineering that is reinforced over the years. We just have to shift away from the traditional idea of what engineering is and *who* engineering is for.

Limitations And Future Work

However, we would like to acknowledge that this study does have some bounds, the largest of which is the limit of three cases. We believe that we have not reached the saturation point for qualitative data and would like to increase the number of participants in the future. This includes broadening the demographics present in the current demographic pool along with the number. It is promising that with only three cases, findings as significant as these were present. However, with increased participant diversity and number, the findings may be even richer and more salient. Providing a ground to explore the current findings further and see if they apply to a much broader pool of participants. Lastly, I would like to take the work in the future to broaden our participation pool and reach a point where we can perform this study across institution types. We can then compare the constructs that university students identify as important to that of community college students in engineering, with the hopes that we can begin the process of bridging the gap between the two institution types starting with retention.

References

[1] American Society for Engineering Education. (2022). Profiles of Engineering and Engineering Technology, 2021. Washington, DC.

[2] Hankey, M. S. , Burge, P. L., Knight, D. B., Seidel, R. W.,& Skaggs, G. (2019). Community college engineering student's perceptions of classroom climate and fundamental engineering skills. Community College Journal, 43(7), 494-504.

[3] Chubin, D., May, G. S., & Babco, E. L. (2005). Diversifying the Engineering Workforce. *Journal of Engineering Education (Washington, D.C.)*, *94*(1), 73–86. https://doi.org/10.1002/j.2168-9830.2005.tb00830.x

[4] Rodriguez, S., & Blaney, J. M. (2021). "We're the unicorns in STEM": Understanding how academic and social experiences influence sense of belonging for Latina undergraduate students. *Journal of Diversity in Higher Education*, *14*(3), 441–455. https://doi.org/10.1037/dhe0000176

[5] Rainey, K., Dancy, M., Mickelson, R., Stearns, E., & Moller, S. (2018). Race and gender differences in how sense of belonging influences decisions to major in STEM. *International Journal of STEM Education*, *5*(1), 1–14. https://doi.org/10.1186/s40594-018-0115-6

[6] Slaten, C. D., Elison, Z. M., Deemer, E. D., Hughes, H. A., & Shemwell, D. A. (2018). The Developmentand Validation of the University Belonging Questionnaire. Journal of Experimental Education,86(4), 633–651. https://doi org.ezproxy1.lib.asu.edu/10.1080/00220973.2017.1339009

[7] Hoffman M., Richmond J., Morrow, J., and K. Salomone, "Investigating sense of belonging in first-year college students." Journal of College Student Retention, vol. 4, no. 3, pp. 227-256. 2003.

[8] Bahr, R. P., Jackson, G., McNaughtan, J., Oster, M., & Gross, J. (2017). Unrealized Potential: Community College Pathways to STEM Baccalaureate Degrees. The Journal of Higher Education (Columbus), 88(3), 430–478. https://doi.org/10.1080/00221546.2016.1257313

[9] Ingram, D. (2012). College Students' Sense of Belonging: Dimensions and Correlates. ProQuest Dissertations Publishing.

[10] Baumeister R. F., and Leary M. R., "The need to belong: Desire for interpersonal attachments as a fundamental human motivation."Psychological Bulletin, vol. 117, pp. 497-529, 1995.

[11] Lee, E., Bekki, J. M., Carberry, A. R., & Kellam, N. N. (2021). *Conceptualization and situating of sense of belonging among international engineering doctoral students: In light of the previous literature*. Paper presented at CoNECD 2021, Virtual, Online.

[12] Allen, K., Kern, M. L., Vella-Brodrick, D., Hattie, J., & Waters, L. (2018). What Schools Need to Know About Fostering School Belonging: a Meta-analysis. *Educational Psychology Review*, *30*(1), 1–34. https://doi.org/10.1007/s10648-016-9389-8

[13] Allen, O. T., Thompson, M. L., & Collins, S. (2022). How Do Latinx Dual Credit Earners Describe Their Sense of Belonging in Engineering Programs? *Journal of College Student Retention : Research, Theory & Practice*, *24*(1), 3–19. https://doi.org/10.1177/1521025119898153

[14] Chang, M., Sharkness, J., Hurtado, S., & Newman, C. B. (2014). What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. *Journal of Research in Science Teaching*, *51*(5), 555–580. https://doi.org/10.1002/tea.21146

[15] Boone, H., & Kirn, A. (2016). First Generation Students Identification with and Feelings of Belongingness in Engineering.

[16] Hausmann, L., Ye, F., Schofield, J. W., & Woods, R. L. (2009). Sense of Belonging and Persistence in White and African American First-Year Students. *Research in Higher Education*, *50*(7), 649–669. https://doi.org/10.1007/s11162-009-9137-8

[17] Meeuwisse, M., Severiens, S. E., & Born, M. P. (2010). Learning Environment, Interaction, Sense of Belonging and Study Success in Ethnically Diverse Student Groups. *Research in Higher Education*, *51*(6), 528–545. https://doi.org/10.1007/s11162-010-9168-1

[18] Pittman L. D., and A. Richmond A. "University belonging, friendship quality, and psychological adjustment during the transition to college." The Journal of Experimental Education, vol. 76, no. 4, pp. 343-362. 2008.