Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025
Paper ID #46095

Bridging Support Networks: The Role of Formal and Informal Mentors in Undergraduate Engineering Students' Emotional Well-Being and Academic Success

Mrs. Narjes Khorsandi Koujel, Rowan University

Narjes is a Ph.D. student in Engineering Education at Rowan University. She earned a bachelor's degree in industrial engineering in Iran and subsequently worked as an industrial engineer in the food industry for over 10 years. Narjes' research and activism focuses on women in the Middle East. Particularly, she is focused on how resources, culture, and gendered norms impact their engineering identity development.

Sowmya Panuganti, Purdue Engineering Education

Sowmya Panuganti is a graduate student at Purdue University in the Engineering Education department. She is passionate about understanding engineering culture and the effects it has on engineers' mental health and well-being.

Dr. Justin Charles Major, Rowan University

Dr. Justin C. Major (they/them) is an Assistant Professor of Experiential Engineering Education at Rowan University where they leads ASPIRE Lab (Advancing Student Pathways through Inequality Research in Engineering). Justin's research focuses on low-income students, engineering belonging and marginalization mechanisms, adverse childhood experiences, and feminist approaches to EER, and connects these topics to broader understandings of student success in engineering. Justin completed their Ph.D. in Engineering Education ('22) and M.S. in Aeronautics and Astronautics ('21) at Purdue University, and two B.S. in Mechanical Engineering and Secondary Mathematics Education at the University of Nevada, Reno ('17). Atop their education, Justin is a previous NSF Graduate Research Fellow and has won over a dozen awards for research, service, and activism related to marginalized communities, including the 2020 ASEE ERM Division Best Diversity Paper for their work on test anxiety. As a previous homeless and food-insecure student, Justin is eager to challenge and change engineering engineering education to be a pathway for socioeconomic mobility and broader systemic improvement rather than an additional barrier.

Bridging Support Networks: The Role of Formal and Informal Mentors in Undergraduate Engineering Students' Emotional Well-Being and Academic Success

Abstract

This research paper explores how mentors shape undergraduate engineering students' sense of emotional well-being and academic success. Our prior work finds that emotional support is integral in supporting students' sense of belonging. This work focuses on the impact of traditional and chosen family students identified as "mentors," including siblings and faculty and staff members. Using a narrative inquiry approach, we explored the type of mentorship that nine engineering students from a mid-Atlantic university receive and the role these mentors play in providing them with emotional support. Analysis of narratives was used to identify themes presented. Prior analysis found that chosen families provided judgment-free zones to students, allowing students to feel a better sense of support. We found that, unlike most traditional families, siblings created a judgment-free zone like that of the chosen family. Faculty and staff similarly provided the same type of space. The total support from mentors resulted in holistic support through academic guidance, emotional encouragement, and role modeling. The outcomes of this study signal a need to develop (in)formal support structures for students at academic institutions. Space is required for mentorship that supports students emotionally. Findings and implications are discussed further.

Introduction

Mentorship has long been considered one of the cornerstones of personal and professional development, from the arts to the sciences [1]. Within higher education, mentorship can be both formal and informal in nature, encompassing everything from faculty-student relationships and workplace mentoring programs to familial or peer connections. These relationships provide emotional support, practical guidance, and role modeling that influence growth and success [2]. By addressing the diverse needs of mentees, mentorship serves as a critical tool to navigate challenges, cultivate resilience, and achieve long-term aspirations [3]. While much emphasis has been placed on formal mentorship programs, informal mentorship has been cited as a strong yet feasible alternative. Trust and emotional connections from informal mentoring networks, usually within the family or peer groupings, are typically wanted in formal programs [4].

Formal mentorship involves structured, institutionally-sanctioned relationships, such as faculty-student advising or workplace mentoring programs, which often focus on career advancement, skill development, or academic achievement [2], [5]. Informal mentorship develops organically from repeated and substantive contact with persons who reinforce mentees' sense of connection and provide them with personalized support [6]. These relationships are usually less formalized, yet powerful, based on trust, shared experiences, and emotional connections. It is in such contexts, when students have to deal with particular systemic barriers or personal adversity, that the impact of informal mentorship becomes transformative. Informal mentors, on their part, have been shown through research to provide specific guidance and support relevant to personal and professional development [7]. Informal mentorship holds a unique flexibility in being impactful and relatable to individuals maneuvering an increasingly complex educational or professional environment [8]. Moreover, informal mentoring plays an important role in organizational and academic settings by creating developmental networks through interpersonal trust and experiences shared among individuals [9]. In contrast, formal mentoring relationships can be thought of more like interventions [10]. Both forms of mentorship play an important role in students' lives.

In educational settings, mentorship plays a pivotal role in shaping students' academic and personal development. Studies have shown that students engaged in positive mentoring relationships are

more likely to persist in their programs, achieve higher levels of academic success, and report greater overall satisfaction with their educational experiences [2] These findings are particularly true in fields like STEM, where the demands of coursework and the stakes for success are perceived as heightened [11]. Mentorship is highly valued in these high-complexity and stressful fields. The academic rigor, emotional strength, adaptability, and problem-solving skills the disciplines comprising STEM require are heavy [11]. Overcoming such challenges often requires good support structures whereby mentors guide, encourage, and reassure. Mentorship enhances confidence and creates a sense of belonging that encourages persistence in rigorous settings [12].

Outside of higher education, mentorship is thought to begin at home, with family members serving as the first informal mentors a child meets. Siblings, parents, and extended family members play an instrumental role in shaping students' attitudes toward education, instilling values of perseverance, and fostering curiosity [13]. As students journey on in their academic pursuits, mentorship extends to teachers, counselors, and peers, where each contributes uniquely to the growth of the other [14]. These relationships are valuable during periods of transition, such as the transition from high school to college or from undergraduate to graduate studies, where students must confront challenges with which they are unfamiliar [15].

Beyond the classroom, mentorship profoundly impacts personal development and emotional well-being. Mentors often act as sounding boards, helping individuals navigate life's uncertainties and make informed decisions [16]. By providing a safe space for open dialogue, mentors can help their mentees develop self-awareness, confidence, and a sense of purpose [16]. By providing an avenue for open dialogue, mentors enable their mentees to develop self-awareness, confidence, and a sense of purpose [11]. These skills are important in ensuring success not only in academics or professional settings but also in general life satisfaction and mental health [17]. Mentorship allows for the opportunity to develop important life skills like communication, critical thinking, and time management. These forms of success are developed through seeking and receiving guidance, reflecting on feedback, and applying learned principles in real situations [18]. By supporting students' pursuits, mentorship helps individuals handle challenges independently and equips them with skills necessary for success in whichever situations they meet [19].

In our previous work on engineering students' support systems, we explored the similarities and differences between the support provided by chosen and traditional families [20], [21]. Chosen family refers to the family that one chooses. These families can include friends, peers, and teachers who help support someone in many ways [22], [23]. Traditional family refers to the family that one is born or adopted into [22]. In our previous work, we found that chosen families often provide emotional support that traditional families do not [21]. Quite often in parent-child relationships there existed expectations that students felt they needed to adhere to out of obligation. However, this type of societal pressure seems to be less prevalent in sibling relationships as we will discuss below, what we believe is due to the lack of financial obligations or the lack of generational divide [21]. As we continued the analysis in this paper, we realized that within these family types exist both formal and informal mentors. The goal of this paper is to gain a better understanding of the role that these mentors play in engineering students' lives. We also want to understand better what informal mentors look like and the type of people who end up in these roles. In order to better explore the effects of mentorship for engineering students, we seek to answer the following RQ:

RQ1: What roles do formal and informal mentors amongst students' traditional and chosen families play in engineering students' academic success and well-being?

Theoretical Framework

This study is grounded in Kram's Mentor Role Theory, which outlines mentorship as a multidimensional relationship encompassing career-related and psychosocial support. Kram [29] identified key mentoring functions such as role modeling, sponsorship, coaching, exposure, and emotional support, which align with the dual roles mentors play in engineering students' lives. In our findings, siblings serve as informal mentors by providing academic guidance and role modeling, a function closely related to Kram's career-developmental support. In contrast, faculty members often extend their roles beyond traditional formal mentorship, offering psychosocial support by fostering students' confidence and holistic growth. These overlapping mentorship roles undermine binary rigidity and illuminate how mentorship relationships develop naturally out of trust, shared knowledge, and emotional needs. Using Kram's framework enables us to decode the dynamic character of the mentorship roles with greater ease and places a strong emphasis on the need for institutions to support both informal and formal networks of mentorship.

Methods

This study is part of a larger research project that focused on undergraduate engineering students' support systems. This paper explores how formal and informal mentors, as identified by students, contribute to shaping those students' sense of emotional well-being and academic success. To explore this relationship, nine students attending a Mid-Atlantic university were recruited through an open solicitation sent to the entire engineering student body. Students who responded were interviewed. Volunteered demographic information for recruited participants is shown in Table 1. These nine students were interviewed for approximately 60 minutes using open-ended prompts like "Tell us about your support network" to prompt students to share experiences with mentorship and support networks. This method of open-ended prompts was chosen as it allows participants to supply personal stories, enabling the construction of their stories and a focus on those experiences most relevant to their perception of support [24]. This method is central to our commitment to social justice giving voice to students' lived experiences and perspectives [25].

Table 1. Participants demographics.

Participant	Gender	Race/Ethnicity
Alex	Male	White
Avery	Female	Latinx
Doug	Male	Black
Ginger	Male	White
Kevin	Male	White
Link	Female	White
Lawrence	Female	White
Phil	Male	White
Savannah	Female	White

The interview audio was transcribed by Otter.AI. Transcripts were anonymized by the first two of three authors to ensure research quality and participant privacy. Pseudonyms were chosen by the students for themselves and their social network in order to protect participant privacy.

We used a process of "restorying" [26], [27], in which interview data were organized into coherent, first-person narratives. Turning the participants' stories into narratives allows for the exploration

of personal stories, providing a rich, detailed understanding of each participant's experience [26], [28]. It is important to note that while our guiding questions did not include the word mentorship, *this was a phrase that participants used when referring to certain people who support them*. Narratives were analyzed using an analysis of narratives approach, where recurring themes and patterns were identified across all participant stories [28]. This analysis was done by using NVIVO software to inductively code the narratives and identify emergent themes that reflect the nuances and complexities of students' formal and informal mentors. Members of the research team (Authors 1 and 2) coded each narrative independently, developed individual codebooks, and then merged them to create a final codebook, reflecting collective interpretations.

Limitations

As with all narrative work, we acknowledge that we as researchers constructed narratives. Therefore these narratives are highly influenced by us and our particularly positionalities [specifics redacted for review]. However, we strived to make sure that we used as many of the participant's own language to preserve the authenticity of their stories. Additionally, we note that this paper explores topics that were not originally expected in our research design. While participants brought up mentorship, a more focused study on mentorship specifically would be useful.

Results

Although our analysis categorizes mentorship as informal sibling-based and formal faculty-based, we note that these categories are dynamic. Both siblings and faculty provide a mixture of professional, emotional, and academic advice, depending on relational dynamics and student needs. From our findings, it is clear that mentorship is not compartmentalized but happens organically based on support networks of a student and their experiences.

Theme 1: Sibling Relationships as Informal Academic Mentors

The first theme we identified focused on siblings as informal mentors, who provided academic guidance, emotional support, and role modeling that circumvented our initial findings that traditional family came with specific expectations and stress. This type of mentorship was shaped by family dynamics that included closeness, shared interests, and gender roles. We found sibling relationships support engineering students in their well-being and persistence because they provide tailored guidance based on shared experiences and earned trust. This theme directly relates to our RQ1 by highlighting the role siblings play as informal mentors and how their mentorship contributes to emotional resilience and academic success for students.

Subtheme 1: Receiving Mentorship from Older Siblings

Several students clarified that their older siblings served as unofficial mentors to them, offering educational guidance, emotional support, and guidance in areas of STEM. For example, Kevin clarified that his older brothers, graduates in STEM, assisted in his educational career:

> My sister is older, my brother is the middle child. I guess I'm the youngest. My brother has an electrical engineering degree, my sister has a biology degree. They both graduated from here […] I kind of like put the two together academically, my brother Jared is an engineer, so he kind of knows some stuff. My sister, Olivia, used to help me with some organic chemistry because she has taken those classes.

Kevin's experience illustrates career-related mentoring functions, as outlined in Kram's Mentor Role Theory. His older siblings provided direct academic assistance, particularly in STEM subjects, which strengthened his understanding and persistence in engineering. Having siblings who successfully navigated STEM careers reinforced Kevin's confidence in his ability to succeed in the field. Similarly, Avery reflected on how her older siblings served as role models, reinforcing her belief that she could excel in both academics and extracurricular activities:

> I have a brother, and I have a sister, Olivia, who is six years older than me. She graduated from college with a marketing degree and she had almost like a 4.0. I would say that she's a really good example for me. My dad is a really good example too, and so is Zack, my brother […] Zack, he's, I would say, he's pretty interesting. He is also in a frat at another University. So, I would say in a way of him being able to do his frat and also still achieve good grades and engineering, it gave me the confidence that I knew that I could come to college and beyond an athletic team, and do my engineering degree and still be able to do well in both aspects.

Avery's narrative highlights the importance of role modeling in informal mentorship. Observing her siblings' success provided her with tangible examples of academic achievement and time management, reinforcing her sense of belonging and self-efficacy in STEM. This aligns with psychosocial support functions in mentoring theory, where mentors help mentees develop confidence and manage stress.

Subtheme 2: Providing Mentorship to Younger Siblings

While many students received mentorship from older siblings, others found themselves transitioning into the role of mentor for their younger siblings. This shift was particularly significant as it reinforced their own academic knowledge and leadership skills.

For instance, Savannah described her experience mentoring her younger brother:

> Cole is a junior in high school, I think. And he's kind of in the same situation as me; he's in the STEM program, the engineering part of it. He always asks me–like, you know, since I took these classes– he would ask if I struggled with any of them–I think right now they're doing like a coding project. And I was like, "Oh, I'm not too good at coding. So, I can't help you out there. But I'll help you out with anything else."

In this passage, Savannah describes acting as an informal mentor, advising and even comforting her brother based on her academic experiences. Savannah reflects on how experiences inform her ability to help her brother navigate his challenges. This dynamic not only helps her brother but also empowers Savannah with more confidence in her knowledge and her ability to support others. As Savannah guides her brother through difficulties, she reinforces for herself an identity as an engineer and fosters her brother's persistence in STEM education. Kram's theory suggests that mentorship is not unidirectional. Mentors also benefit through increased self-confidence and reinforcement of their own expertise.

Similarly, Alex describes how taking on the role of an informal mentor for his younger brother has affected him throughout both his academic and personal life. He reflects:

> My little brother just turned 16, I am eight years older. So, I don't know, I guess he was like, somebody who had to grow up. And I wanted to be a responsible older brother. And now he wants to do engineering just like me which is nice. But yeah, I had to grow up a lot too. Because, you know, I didn't have an older brother, older brother to like, teach me. So, I think it's, it's nice that I assume that role.

For Alex, mentoring his younger brother reinforces his sense of responsibility and commitment to his own academic goals. This reciprocal relationship highlights how siblings inspire and motivate each other, creating a shared pathway toward success in engineering. Alex's experience illustrates how the mentorship dynamic benefits both siblings, fostering their sense of resilience and purpose.

These examples show how one can be a mentee or a mentor in a sibling relationship. These participants show how sibling relationships can help shape one's career path and provide motivation and academic support. The special bond that siblings share from having been raised in similar environments allows them to act as informal mentors. In sibling relationships where there are shared academic or professional interests an inspiring feedback loop can be created between the mentor and mentee.

Theme 2: Mentorship Beyond Academics, Holistic Personal Growth

Our second theme centers around the idea that mentorship, both formal and informal, extends beyond the confines of academic support to foster holistic personal growth. While mentors in engineering programs are often seen as academic guides, their influence frequently touches upon the emotional, social, and personal dimensions of a student's life. This mentorship is also key to helping learners overcome the harsh pressure of the STEM environment that is bedeviled by challenges of the imposter syndrome, hard course work, and representation that have negative effects on persistence. This theme explores how mentors serve as anchors not only in academic success but also in shaping the personal development, emotional resilience, and life navigation of their mentees.

Subtheme 1: Emotional and Moral Guidance

The first subtheme we identified recognizes the importance of mentorship reaching beyond academic confines to emotional and moral advice. Kevin reflects on his relationship with his formal mentor, Barrett, an electrical engineer who also helps lead his Bible study group. Kevin explains that their discussions go far beyond technical guidance. He states:

> I have a mentor, Barrett. He's an electrical engineer. He's either 31 or 33. I forget. So he's a little bit older. I got some advice a little bit ago, "you need people older than you to be like a mentor outside of family". So, I try to take that into account. He also kind of like he helps lead the Bible study I go to, he's on staff. So, we have that and engineering in common. He's a chunk older than me and he can kind of tell me what's going on. We meet like every other week on Tuesdays. And we'll just talk about life, what's going on, what we can do better- things like that. He gives me advice and I can talk to him about things. He helps make sure I'm going down the right path.

Here, Kevin highlights how Barrett can be helpful for engineering context and advice. But Kevin states that he seeks out Barett because he provides him with moral, spiritual, and life guidance.

Barrett's mentorship helps Kevin navigate not only his chemical engineering coursework but also the broader life decisions he faces as a young adult. Kram's [29] Theory of the Mentor Roles aligns with psychosocial mentoring in which mentoring involves role-modeling, counseling, and emotional support that reinforces feelings of belonging and hardiness in learners. For high-stakes careers like engineering where perseverance hinges on confidence, mentoring that involves moral mentoring has the potential to ease self-doubt and aid learners in developing more robust professional and personal identity. This holistic approach to mentoring allows Kevin to develop a well-rounded perspective on his academic journey, feeling supported in multiple areas of his life.

Subtheme 2: Personalized Support in Academic and Life Decisions

In this subtheme, we identified how having tailored mentoring is beneficial. In her narrative, Lawrence describes the actions of Dr. Smith, who has taken on the role of an informal mentor. Dr. Smith offers consistent personal support that helps her manage the pressures of both her academic and career goals. Lawrence shares:

> I would say Dr. Smith has been a huge help. I always go for her for like registration issues and stuff like that. She gave me guidance on like her feedback for that, which I think really helps. She's always like, very passionate for all the students. I mean, I don't get to see her that much. I had a class with her. She taught a class, I think, sophomore year, I would say it was one of the tougher classes back then. So, I used to go to office hours with her, and she would help me with projects, homework, or whatever, just to understand the material better. So, she was always like, willing to meet. I would say like that the whole thing about her is, I know, she's a very busy woman, but yet she always finds time for her students, like when or need of whatever.

Dr. Smith's personalized advice and availability reflects her investment in Lawrence's academic success and informed decision-making about her future. Even though the mentorship focuses on academic and professional support, reassurance and care by Dr. Smith also helps Lawrence deal with the stress of her demanding program. Mentorship research has established that faculty mentoring has a vital role to play in the academic integration of students that is needed for retention in STEM careers [15]. Through the facilitation of personally supportive faculty mentoring, informal faculty mentoring has potential to bridge emotional and academic challenges that confront engineering students but more so for underrepresented ones. This level of mentorship shows how the faculty can help students develop confidence by giving them individualized attention, which emboldens them to take up not only academics but also their career goals. Dr. Smith's commitment is one good example of how mentors can affect students.

Subtheme 3: Building Confidence and Independence Through Mentorship

Mentorship also plays a significant role in shaping students' professional identities. Phil shares how his professor, Dr. Patel, guided him not just through technical projects but also created a safe space for students to ask him for life advice. Phil explains:

> Outside of my peers in engineering, I think that Professor Patel is also supportive. He's my favorite professor here. He's great. He does computer architecture classes here. I think he's the most inspiring professor for me, and he's very personal. He feels like a, like a family member in some ways [...] I just feel like he's another one of

> those people, where if I had to confide in him I could. He also was very encouraging academically [...] So he's just very good in that regard, of like, giving us like, a good amount of direction, but also giving us the freedom to figure this stuff out ourselves, and, and find our own pace to work through it. He also tells us that he supports us, he just says it. He loves talking to his students. And he's like, kind of given me--there's some times he's kind of like giving me unsolicited life advice. So I just feel like I know if I really didn't have anybody else, he would be there for me.

While Dr. Patel is not an assigned formal mentor to Phil, his position and expertise put him in a place to provide Phil and other students with invaluable advice. Dr. Patel balances guiding the right amount and giving freedom so that Phil learns to own up to his academic difficulties as well as personal decisions. Kram [29] opines that mentoring plays a crucial role in shaping self-efficacy through challenge and support. This is of particular significance in engineering, where having confidence in solving problems is vital to success in the future. STEM mentoring research identifies how faculty mentoring gives confidence that, in turn, makes learners more tenacious in challenging courses [12]. Dr. Patel gives some life lessons in some instances; however, more prominent this mentorship gives a pathway to find himself at certain places in his technical or making any personal decisions in life. This type of mentorship helps Phil build confidence that he can not only solve his problems but also get through the uncertain moments of his life. Dr. Patel provides a type of mentorship that helps build self-sufficiency in the students so that they become resilient and sure of themselves, taking up any challenge either at an academic or personal level. This often cultivates vital skills in individuals, like confidence, autonomy, and how to overcome challenges. Phil's experience with Dr. Patel exemplifies how a mentor's encouragement can transcend academia and inspire personal growth and self-sufficiency.

Subtheme 4: Encouraging Growth Through Empathy and Flexibility

The last subtheme that we identified focuses on the empathy involved in mentoring and how beneficial it can be. Avery highlights how her professor, Professor Smith, provides a deeply empathetic and flexible approach to teaching, which fosters both emotional resilience and academic success. Avery shares:

> I would say, my like main professor, Professor Smith is one of my favorite professors. He actually sent surveys once a week to get our feedback about the likelihood we thought that we thought we were gonna get an A in this course, our emotional stress level, if we think that there was too much homework, or if we maybe need more to help us understand things. If we have like, any sort of lingering questions about the lab or the lecture, then there's like little text boxes for you to input like, “I really liked the lecture,” or “I was a little bit confused with the lab.” And I've actually seen that over the weeks, things have changed a little bit. We had a midterm last week so he didn't give us another assignment. If we're struggling in a lab and we need a few extra days to do it, he'll give us that time, instead of just being like, “oh, well, too bad. Like, you have to manage your time”. He understands that we have a bunch of other courses that we're taking. It's nice because not only does he like understand us, but even when I'm going through, like, the fact that I have to retake some courses, and like, you know, that doesn't feel great. But he's told us many times, like, “this was the third time I had to take this class, and I didn't understand it until recently, until like, that

> time I took it. So, if any of you guys are retaking any classes, like, don't worry, like I did that too." Professor Smith, just the way he treats his classes and like, the way he cares about us, it's like none of my other professors do what he does.

As Avery describes, Professor Smith is an empathetic and flexible instructor. Social-emotional learning theories hold that supportive classrooms build student engagement that is of special significance in demanding STEM classes [16] . Professors like Professor Smith play a crucial role in helping learners build their resilience through the normalization of difficulties and adjustment in learning. Avery says, "He constantly requests feedback through weekly surveys on emotional stress levels and areas of the course difficulty and refines his teaching methods to adapt to the student's needs". Professor Smith allowing extensions on assignments when students are struggling proves to Avery that he understands the pressures that exist. By sharing his experiences of having to retake courses, Professor Smith normalizes setbacks and reassures students like Avery that they are not alone in feeling underprepared. This supportive approach helps students overcome feelings of inadequacy, bolsters their confidence and emotional well-being, and enables them to thrive in challenging environments.

This second theme highlights the importance of the role of informal and formal mentors in supporting students outside of academics. While academics are a large part of these engineering students' lives' they are more than engineers. Emotional, career, and social facets of mentoring have a crucial impact on persistence in degree programs in engineering, and integrated mentoring methods must take center stage in higher education environments. All these students face struggles outside of the classroom, and these mentoring relationships provide them with some level of academic guidance, support, life advice, empathy, and confidence.

Concluding with the results of this research, Theme 1 reflects the informal mentorship of siblings. Mentorship is a natural aspect that comes with learning with siblings with the siblings filling the informal mentorship and role models roles. Older siblings are the most likely to fill this role by giving academic advice and a sense of belonging. Theme 2 stresses the value of comprehensive mentorship to aid engineering students. Academics are paramount, with meaningful mentorship going well beyond the course work to include the personal and the emotional. Combined, Themes 1 and 2 describe the ways that informal and formal mentors deliver the necessary academic support with the added support of emotions that aid the student to excel comprehensively.

Discussion

From these narrative interviews, we found siblings to play a large role in the mentorship of engineering students. Students often look to their siblings for career guidance or even learn more about their needs by guiding younger siblings. By incorporating academic guidance, emotional support, and role modeling, sibling relationships form a key informal mentorship network for engineering students. Siblings, having often grown up together, share a privileged position in each other's lives. Their deep understanding of the family dynamics and pressures can allow them to support each other with specific advice and similar life experiences [13]. Such mutual understanding fosters persistence in challenging academic programs and creates a sense of belonging in their support networks. Engineering students face high course loads, imposter syndrome, and pressures of underrepresentation in STEM [30]. These challenges are even more acute for students at the intersection of marginalized gender and racial/ethnic identities, who often

face compounded inequalities in accessing emotional, social, and physical resources necessary for STEM persistence [31]. Siblings and faculty mentors help to facilitate overcoming these challenges by affirming technical self-confidence, providing networks, and forming a STEM identity that is key to perseverance in the profession.

In these narratives, it becomes clear that mentorship in engineering extends far beyond academic guidance. Mentors often step into roles that involve emotional coaching, career counseling, personal development, and life management. Their support empowers students to navigate both technical challenges of their coursework and complex challenges of young adult life [12]. This holistic approach to mentorship helps students develop emotional resilience, build professional confidence, and manage their well-being alongside their academic ambitions [16], [19]. This theme of holistic mentorship highlights the different kinds of support students need to thrive in engineering programs. By addressing both academic and personal aspects of students' lives, mentors play a role in shaping well-rounded individuals who can be successful in many aspects of life [16].

Our results show the importance of having formal and informal mentorship in supporting students. Sibling mentorship and personalized guidance by faculty are instrumental in developing resilience, confidence, and a sense of belonging to be successful in a demanding field like engineering. These findings establish that universities and organizations should create avenues for mentorship, not only academically but emotionally and personally. Programs that encourage informal mentorship through families, peer groups, or faculty relationships are better at helping students tackle challenges more effectively and ensuring overall growth. Moreover, any training that makes the mentors flexible and empathetic enhances the positivity in the relationship even further for students to feel valued and motivated.

Implications, Conclusions, and Future Work

This study identifies informal and formal mentoring as crucial in shaping academic performance and emotional well-being of engineering students. Formal mentors often provide academic advice, while informal ones, like siblings or chosen families, offer emotional support, personality building, and confidence-building. Findings identify that there is not a sharp demarcation between informal and formal. Mentoring is fluid where mentors provide support based on student needs. Universities should encourage faculty and peer mentoring programs. Faculty mentoring should be flexible and support both academic and personal growth as well as emotional needs. Faculty can also connect students with other informal mentors like peers and alumni. Student-led mentoring initiatives could strengthen students' sense of belonging. Inclusive mentoring structures are essential for first-generation and underrepresented students. Students should be encouraged to actively seek mentorship and participate in peer mentoring to build a strong support network.

Future research must investigate how mentoring differs for students from varying background experiences, like first-generation college students and members of historically underrepresented STEM groups. Research on the effects of mentoring by older siblings in engineering could offer more insight on how informal mentoring affects career choices. Research on online and blended mentoring approaches might yield new methods of broadening reach and participation. Exploring and providing the support needed as student transition from undergraduate to careers can also broaden the impact institutions have. Through these measures, institutions would establish solid

structures of mentoring that offer academic, emotional, and career support to learners. Stabilizing mentoring structures in engineering education would improve retention and success of learners.

References

[1] W. B. Johnson and K. A. Griffin, *On being a mentor: a guide for higher education faculty*, 3rd edition. Abingdon, Oxon ; New York, NY: Routledge, 2024.

[2] G. Crisp and I. Cruz, "Mentoring College Students: A Critical Review of the Literature Between 1990 and 2007," *Res High Educ*, vol. 50, no. 6, pp. 525–545, Sep. 2009, doi: 10.1007/s11162-009-9130-2.

[3] D. L. DuBois and N. Silverthorn, "Natural Mentoring Relationships and Adolescent Health: Evidence From a National Study," *Am J Public Health*, vol. 95, no. 3, pp. 518–524, Mar. 2005, doi: 10.2105/AJPH.2003.031476.

[4] Y. P. Bynum, "The Power of Informal Mentoring," *Education*, vol. 136, no. 1, pp. 69–73, 2015.

[5] L. T. Eby, T. D. Allen, S. C. Evans, T. Ng, and D. L. DuBois, "Does mentoring matter? A multidisciplinary meta-analysis comparing mentored and non-mentored individuals," *Journal of Vocational Behavior*, vol. 72, no. 2, pp. 254–267, Apr. 2008, doi: 10.1016/j.jvb.2007.04.005.

[6] S. McMahon, "Creating a Culture of Informal Mentoring at Community Colleges: Conditions that Strengthen and Weaken Relationships and Students' Structural Resiliency," *Educational Leadership & Workforce Development Theses & Dissertations*, Dec. 2020, doi: 10.25777/ebqz-z406.

[7] J. M. James, A. Rayner, and J. Bruno, "Are You My Mentor? New Perspectives and Research on Informal Mentorship," *The Journal of Academic Librarianship*, vol. 41, no. 5, pp. 532–539, Sep. 2015, doi: 10.1016/j.acalib.2015.07.009.

[8] L. D. Inzer and C. B. Crawford, "A Review of Formal and Informal Mentoring: Processes, Problems, and Design," *Journal of Leadership Education*, vol. 4, no. 1, pp. 31–50, Jun. 2005, doi: 10.12806/V4/I1/TF2.

[9] S. Janssen, M. Van Vuuren, and M. D. T. De Jong, "Informal Mentoring at Work: A Review and Suggestions for Future Research," *Int J Management Reviews*, vol. 18, no. 4, pp. 498–517, Oct. 2016, doi: 10.1111/ijmr.12069.

[10] D. Murray, "The benefits of formal vs informal mentoring." Accessed: Jan. 12, 2025. [Online]. Available: https://www.go1.com/blog/the-benefits-of-formal-vs-informal-mentoring

[11] M. A. Hutchison-Green, D. K. Follman, and G. M. Bodner, "Providing a Voice: Qualitative Investigation of the Impact of a First-Year Engineering Experience on Students' Efficacy Beliefs," *J of Engineering Edu*, vol. 97, no. 2, pp. 177–190, 2008, doi: 10.1002/j.2168-9830.2008.tb00966.x.

[12] E. Litzler, C. C. Samuelson, and J. A. Lorah, "Breaking it Down: Engineering Student STEM Confidence at the Intersection of Race/Ethnicity and Gender," *Res High Educ*, vol. 55, no. 8, pp. 810–832, Dec. 2014, doi: 10.1007/s11162-014-9333-z.

[13] B. Rogoff, *The cultural nature of human development*. Oxford [UK] New York: Oxford University Press, 2003.

[14] J. Lave and E. Wenger, *Situated learning: Legitimate peripheral participation*. in Situated learning: Legitimate peripheral participation. New York, NY, US: Cambridge University Press, 1991. doi: 10.1017/CBO9780511815355.
[15] V. Tinto, *Leaving College: Rethinking the Causes and Cures of Student Attrition. Second Edition*. University of Chicago Press, 5801 South Ellis Avenue, Chicago, IL 60637 ($24, 1993.
[16] J. E. Rhodes, *Older and wiser: new ideas for youth mentoring in the 21st century*. Cambridge (Mass.): Harvard University press, 2020.
[17] D. L. DuBois, B. E. Holloway, J. C. Valentine, and H. Cooper, "Effectiveness of Mentoring Programs for Youth: A Meta-Analytic Review," *American J of Comm Psychol*, vol. 30, no. 2, pp. 157–197, Apr. 2002, doi: 10.1023/A:1014628810714.
[18] L. Z. Schlosser, S. Knox, A. R. Moskovitz, and C. E. Hill, "A qualitative examination of graduate advising relationships: The advisee perspective.," *Journal of Counseling Psychology*, vol. 50, no. 2, pp. 178–188, Apr. 2003, doi: 10.1037/0022-0167.50.2.178.
[19] Naka, "Overcome Mentorship Challenges: A Guide for Aspiring Mentors," Big Brothers Big Sisters of Long Island. Accessed: Jan. 12, 2025. [Online]. Available: https://bbbsli.org/mentorship-challenges/
[20] S. Panuganti and J. C. Major, "WIP: Accomplices and Allies: The Role of Chosen Family in Empowering Engineering Students," in *2024 ASEE Annual Conference & Exposition*, 2024. Accessed: Apr. 28, 2025. [Online]. Available: https://peer.asee.org/48286.pdf
[21] S. Panuganti, N. K. Koujel, and J. C. Major, "The role of undergraduate engineering students' different support networks in promoting emotional well-being: A narrative study," in *2025 Collaborative Network for Engineering & Computing Diversity (CoNECD)*, 2025. Accessed: Apr. 28, 2025. [Online]. Available: https://peer.asee.org/the-role-of-undergraduate-engineering-students-different-support-networks-in-promoting-emotional-well-being-a-narrative-study
[22] K. Weston, *Families We Choose: Lesbians, Gays, Kinship*. Columbia University Press, 1997.
[23] J. C. Major, "More than income: Socioeconomic inequality, trauma, and the pathways of low-income undergraduate engineering students," Purdue University Graduate School, 2022. [Online]. Available: https://doi.org/10.25394/PGS.20085329.v1
[24] J.-H. Kim, *Understanding Narrative Inquiry: The Crafting and Analysis of Stories as Research*. SAGE Publications, 2015.
[25] C. K. Riessman, *Narrative methods for the human sciences*. in Narrative methods for the human sciences. Thousand Oaks, CA, US: Sage Publications, Inc, 2008.
[26] N. N. Kellam, K. S. Gerow, and J. Walther, "Narrative analysis in engineering education research: 2015 122nd ASEE Annual Conference and Exposition," *ASEE Annual Conference and Exposition, Conference Proceedings*, vol. 122nd ASEE Annual Conference and Exposition: Making Value for Society, no. 122nd ASEE Annual Conference and Exposition: Making Value for..., 2015, Accessed: Aug. 19, 2024. [Online]. Available: http://www.scopus.com/inward/record.url?scp=84941994771&partnerID=8YFLogxK
[27] B. Czarniawska, *Narratives in Social Science Research*. 1 Oliver's Yard, 55 City Road, London England EC1Y 1SP United Kingdom: SAGE Publications, Ltd, 2004. doi: 10.4135/9781849209502.

[28] D. E. Polkinghorne, “Narrative configuration in qualitative analysis,” *International Journal of Qualitative Studies in Education*, vol. 8, no. 1, pp. 5–23, Jan. 1995, doi: 10.1080/0951839950080103.
[29] K. E. Kram, *Mentoring at work: Developmental relationships in organizational life*. University Press of America, 1988. Accessed: Dec. 05, 2024. [Online]. Available: https://psycnet.apa.org/record/1988-97625-000
[30] M. D. Ahandani and J. M. Bekki, “Exploring the Landscape of Graduate Student Mental Health: Populations, Methods, and Terminologies-Who is Missing from the Conversation?,” in *2024 ASEE Annual Conference & Exposition*, 2024. Accessed: Apr. 28, 2025. [Online]. Available: https://peer.asee.org/47438.pdf
[31] N. K. Koujel and J. C. Major, “An Exploration of the Intersectional Distribution of Physical, Social, and Emotional Resources in Engineering,” in *2024 IEEE Frontiers in Education Conference (FIE)*, IEEE, 2024, pp. 1–9. Accessed: Apr. 30, 2025. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/10893500/