Identifying Opportunities for Peer Mentors as Student Social Support Catalyst within a Multidisciplinary First-Year Design Course

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Abstract

Many engineering programs offer a hands-on first-year design course where students learn and practice engineering design skills. Although first-year design courses commonly have integrated learning support and technical training, it is less common for the courses to focus on the social aspects of engineering, such as collaboration, communication, and cultural sensitivity. Social learning is a critical variable influencing first-year students' personal growth and sense of belonging. We argue that student engagement with classroom-based peer mentoring can accelerate and accentuate social learning. Our research focused on the outcome of the social support offered to students transitioning to college as they interact in a design course experience facilitated in part by peer mentors. We researched the first-year student perceptions of the benefits of peer mentor learning facilitation in a makerspace-based team project-centered engineering design course.

Our exploratory research involved collecting input from first-year design students to identify areas of current social support by peer mentors and the areas of need within a makerspace course environment. We analyzed the student responses to identify categories of support that peer mentors currently provide. We also categorize areas of needed support through the lens of longer-term student success, students' sense of belonging, and retention of first-year design students.

We found the students perceived the mentors as positively influencing their learning, working groups, and sense of belonging. The students had few recommendations for enhancing the mentors' effectiveness. Overall, the results indicate that the mentors positively supported student learning and enhanced their success in their first-year design course.

Review of Literature

Study Framework: Supporting Student Development. We framed our research by embracing Chickering and Reisser's [1] seven-vector student development model. The model aligns well with our focus on students working in teams, developing a sense of belonging, increasing their confidence for learning, and gaining a professional identity. The seven vectors are developing professional relationships, enhancing personal competence, monitoring emotions, gaining a personal identity, internalizing a sense of purpose, realizing personal interdependence, and embracing integrity. We argue interactions in student-centered learning environments enhance the opportunity for students to progress in their development along the seven vectors.

Our research focused on the potential influence of peer mentors supporting student learning in a first-year design course taking place in a makerspace. We recognize work in the makerspace is designed to allow students to discover unique solutions and provides students with increased opportunities to lead their learning and development. Peer mentors facilitating learning in the space are positioned to catalyze student development through support in knowledge acquisition, engagement in teamwork, and support the students' sense of belonging. Thus, the peer mentors working in the makerspace facilitating student learning are positioned to facilitate the students' progression in the seven vectors of student development.

Sense of Belonging. All the student development vectors may be impacted through interactions with others [1]. Of interest to us for our research was how the mentors may have influenced the enrolled students' sense of belonging. College students' sense of belonging is critical to their persistence and engagement in campus activities, including learning [2]. Gopalan and Brady [2] report that underrepresented minority and first-generation college students tend to experience lower levels of sense of belonging and, thus, experience greater benefits from efforts to enhance their sense of belonging. Glaser et al. [3] report how peer mentors can enhance students' sense of belonging on college campuses. The impact of peer mentors has been researched in specific situations in engineering education (i.e., Ahmed & Elasaadany [4]), yet the evidence of impact can be contextual. Thus, there is a warrant to examine how peer mentors working with students in their classes may influence the students' sense of belonging within a college of engineering and the university.

Working as a Team. A team-based design course environment provides students with experience and opportunity for skills development. Of interest in this study and course was how students working as a team with peer mentor guidance influenced students' success in forming professional relationships, enhancing personal competence, monitoring emotions, and embracing integrity. The ability to communicate professionally and work in teams is critical in engineering student development to enter the workforce [5]. Student emotional intelligence development is linked to better team performance in the classroom and the engineering workplace [6]. Ethical decision-making and student integrity are enhanced through team discussions [7]. Peer mentors assisting and guiding student groups in interactions and possibly during group conflict resolution may help students grouped together in a makerspace class learn to function as a cohesive team and progress in their vectors of student development.

Developing Confidence. Developing confidence is a critical element of student development [1]. Confidence has been documented to be associated with student academic success [8] with differences in gender and ethnicity [9], such that students of color and females tended to hold lower levels of academic confidence. Thus, there is a need to attend to student confidence development to lead to broader participation in engineering. Enhancing student academic confidence can be complicated and multifaceted (e.g., Gormally et al. [10]; National Research

Council [11]). One approach to enhancing student academic confidence is through their interactions with peer mentors as the mentors facilitate student learning [12]. Fayram et al. [12] report peer mentors positively impact students' academic confidence, motivation, and engagement. The potential for peer mentors to positively influence student academic confidence provides support for examining how peer mentors facilitating the learning of students enrolled in a first-year engineering design course affects the students' confidence development.

Peer Mentors and Fostering Student Communities. Entering college can be an overwhelming time for students. Students finding and being welcomed into a community is critical for students to develop interdependence and, subsequently, their success and persistence as engineering majors [1]. Peer mentors, who are academically more advanced than the first-year students they are facilitating, can foster students' positive and sustained transition into college. Peer mentoring can be particularly critical for the success and retention of underrepresented student populations [13]. We speculate embedding peer mentoring may be even more impactful when integrated into student-centered courses with high levels of project-based learning. Our research focused on a first-year course that took place in a makerspace. In the course, peer mentors were hired to facilitate first-year student learning. A secondary outcome of peer mentors supporting students working in teams to complete projects was to increase the student's sense of belonging in the university engineering and social communities. Thus, we were curious about how the peer mentors' support influenced student development in monitoring their emotions, gaining a personal identity, internalizing a sense of purpose, and realizing personal interdependence.

Method

Research Questions. Our overarching research question for our exploratory study was, *How are peer mentors working in a first-year design course influencing the students' development?* To answer our research question, we developed the following guiding research questions:

- How did the peer mentors influence the students' sense of belonging?
- How did the peer mentors influence the students' ability to work in teams effectively?
- How did the peer mentors influence the students' confidence development?
- What are students' recommendations for what peer mentors could do to foster the student community?

Participants. During the Fall 2022 semester, there were a total of 531 multidisciplinary students enrolled across 11 sections of Engineering Design and Society, a first-year design makerspace-based course. We had 392 students agree to participate in the research study, which included 289

first-year students, 103 sophomores, 42 juniors, and 11 seniors. Due to the small sample size, we did not include the junior and senior students' responses in our study. Further, we desired to document the impact of peer mentors on first-year students. The students' majors are found in Figure 1, ethnic background in Figure 2, and gender is in Figure 3. Note, the one semester course enrolls about 1,250 students annually with about 500 students in fall and spring semesters and 250 in summer semester. Again, our data is limited to the students in the fall 2022 semester.

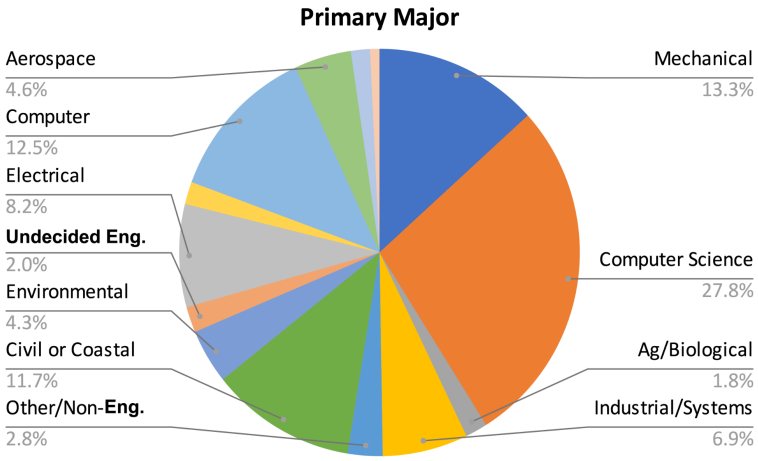

Figure 1: Self-reported primary major distribution of survey participants.

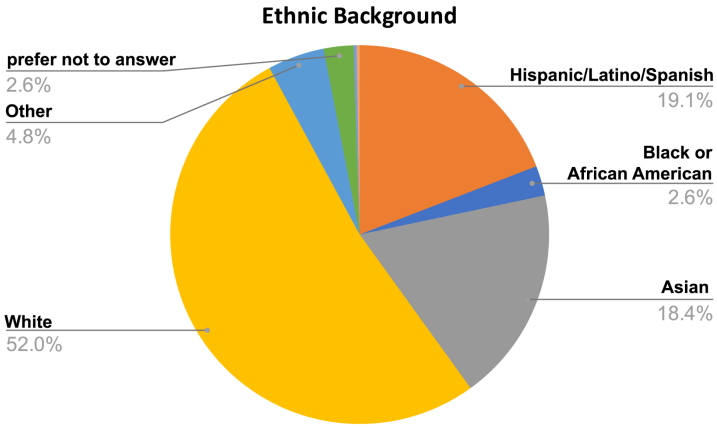

Figure 2: Self-reported ethnic background of survey participants.

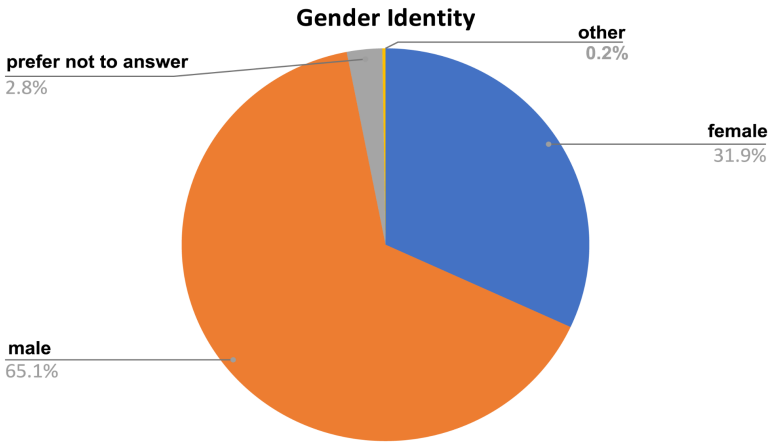

Figure 3: Self-reported gender identity of survey participants.

Design. For our exploratory research, we selected a cross-section survey methodology [14]. Our goal was to establish a baseline of data upon which we could meaningfully explore the impact of peer mentors on the learning and development of the students they are facilitating. We selected survey research because the peer mentors work with about 500 students per semester, and therefore, data collection could most effectively be achieved using a survey. Further, to lower the negative influence multiple surveys have on participant fatigue and engagement we merged our research survey with the end-of-course evaluations (approved by the institutional review board).

Makerspace Course - First-Year Design Course. Engineering Design & Society is a multidisciplinary first-year makerspace-based course in which annually 1,250 students practice human-centered engineering processes to design and create prototypes to benefit society. Students enrolled in the course engage in the human-centered design process while learning and applying makerspace skills (e.g., solid modeling, creating using 3D printing, building microelectronics, incorporating sensors, integrating actuators, using hand tools). Throughout the first ⅔ of the semester, there is a mix of individual and team homework assignments as the students developed technical skills. During the last third of the semester, student teams were issued an open-ended human-centered design challenge project where they apply their knowledge to research, design, build, and document a human-centered prototype to benefit society. The context for our research were the peer mentors assisting within this first-year makerspace-based engineering design course. Course peer mentors assist faculty members within class during active learning activities and hold nighttime peer mentoring hours in the makerspace classroom for open walk-in help for students across all sections of the course. During class, mentors facilitate individual students and teams as they work on learning technical skills then the students apply those skills in creating prototypes. In nighttime mentoring hours (4 pm-8 pm on Tuesdays, Wednesdays, Thursdays), the peer mentors run the makerspace classroom for open walk-in help. In the after-hours lab time, the peer mentors are available for students seeking

support for course-specific assignments, or answers to broader student interest questions (e.g., internships, study abroad, student societies, local social activities, housing).

Survey Development. There was a dual purpose in the survey developed in this exploratory study: a) investigation of the overarching research question of *How are peer mentors working in a first-year design course influencing the students' development?* and b) gathering input for peer mentor program effectiveness and improvements in the course. We structured the survey questions to solicit responses to investigate both our research question and to gather data to be used for evidence-based course improvement. An example of the type of question for this dual purpose is the qualitative question: *Please share how the peer mentors helped you develop confidence in your ability to do engineering.*

We did not review the results until after fall 2022 grades were submitted to retain separation, as one instructional faculty member from that semester is part of the research study team. We surveyed the students by amending additional questions to a Qualtrics based end of course assessment. Thus, all 531 students were to complete the survey. Examining and coding the 392 open-ended responses from students allowed for research analysis based on the frequency of codes. Reading all open-ended responses allowed for course development faculty reflection on how the current peer mentors are, or are not, helping students develop confidence in their roles.

Analysis

Quantitative Data. Given the constraint of not having a control group or pre-post scores for comparison, we determined that the best way to analyze our data was descriptively. Our quantitative data consisted of the frequencies for the five levels of our three Likert scale items. Thus, our analysis focused on calculations of central tendency and variation to report our data descriptively.

Qualitative Data. We analyzed our qualitative data using open coding [15]. Our goal was to expose trends in the data aligned with our research questions. We developed a set of a priori codes based on our expectations of the students' perspectives and experiences in alignment with each survey prompt. We also remained open to new emergent codes as we coded the data. In Table 1, we present our themes (based on our survey prompts) and the associated a priori and emergent codes.

Table 1.

A Priori and Emergent Codes for the Themes Aligned with our Survey Prompts

Theme	Codes
How Peer Mentors Influence Sense of Belonging	Mentor Knowledge, Mentor Experience with the class, Welcoming, Friendly/ Approachable, Provided Course Related Help, Encouraging, Patient, Compassionate/ Empathy, Present/ Available/ Reliable, Guided Learning, Proactive, Motivational, Connect student with others/Making Personal Connections, No Help, Hard work with, Unavailable, No/Very Limited Interaction
How peer mentors helped a group function as a team.	Problem Solving, Available/ Accessible, Did not help teamwork as a group, Technical assistance, No Interaction, Group Instruction (technical), Gave Advice, Team Building, No Comment, Division of Labor, Embraced Team Ideas, Demonstrate Processes, Addressed the Group as a whole, Explained their Thinking When Offering Direction, Understand College Structure
How peer mentors helped develop confidence in ability to do engineering.	Fostering Learning, Supporting Self-Efficacy, Familiarity of the Space/Tools, Supportive, Encouraging, Creating Common Identity, They did not, Limited to No Interaction, Building Self-Reliance, Growth Mindset, N/A, no conflicts, Offered Explanations, Predictable
What peer mentors could have helped with to make others feel more a part of the College of Engineering community.	Positive Statements of Current PM Support, No improvement, N/A, Limited/No interaction, More information about clubs/activities/resources, Share more Experience, Promptness/Availability/Accessibility, Had no impact More interactions, More conversations unrelated to project/task -deeper connection, More Involved, Share more Advice, More Interactive Activities, Feedback, Peer Identification, Workshops, Tool/ Equipment Use, Comfort with the space

For our analysis, we started by reading each response, discussing the response, and our interpretation of the student's input. We then collectively coded the responses. Once we had achieved consistency, we coded a subset of the data independently until we established a Cohen's Kappa greater than 80%. We then coded the data knowing we had established intercoder reliability. We flagged ambiguous responses for discussion and, again, collectively discussed and then coded the responses based on our group interpretation.

Results

Sense of Belonging. Our first research question was, *How did the peer mentors influence the students' sense of belonging?* To answer this question, we examined the outcome of our selected-response item and the coded qualitative data by frequency to determine the extent to which the students perceived the peer mentors may have influenced their belonging. We found the majority of students tended to perceive the peer mentors between neutral and strongly agree with respect to their perceptions of how the peer mentors helped them adjust to college (see Figure 4).

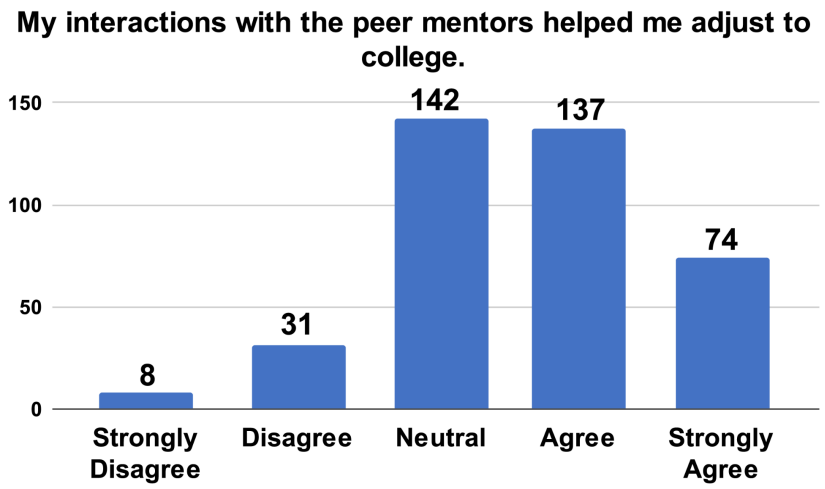

Figure 4: Likert frequency responses on peer mentor impact adjusting to college. Mean value of 3.61 (SD = 0.95) and median value of 4, for 1-5 weighing of likert scale.

We followed our analysis of the selected response prompt by examining the outcomes of the coding analysis of the item related to the participant's perceptions of the peer mentors' influence on their sense of belonging (see Table 2). We found our study participants recognized the knowledge and disposition of the peer mentors as being influential on their sense of belonging. We also found that about 15% of the participants indicated having limited interaction with the peer mentors and therefore did not perceive the mentors as influencing their sense of belonging.

Table 2.

Codes, Frequency, and Responses for Sense of Belonging

Code	**N**	**Representative Response**
Mentor Knowledge	195	They were able to help me understand how Arduino, 3D printing, and many other apps we used worked. Without their help, I would not have done as well, especially on the final project.
Friendly/ Approachable	62	Diverse group of engineering students allowed me to visualize my future in engineering, specifically with higher-level classes. Felt like normal people, not intimidating at all.
No/Very Limited Interaction	58	I didn't have too much interaction with the peer mentors, but when I did, they helped out a ton and were very inclusive.
Present/ Available/ Reliable	54	The peer mentors were extremely helpful. I love how accessible peer mentoring was. All of the times available made it easy to get my questions answered.

Welcoming	50	They were always available during office hours and class to answer our questions. They were both super friendly and welcoming when they would come around and check in on us.
No Help	31	I haven't utilized the peer mentors, so they haven't really influenced me.
Motivational	23	The peer mentors displayed that they were very proficient in working with Arduino and code, while some were only 2nd-year students. This inspires me to ensure that I can achieve that level of understanding and ultimately be able to help those with less experience in the future.
Encouraging	20	They were very encouraging throughout the year and were easy to talk to. They made me feel more confident in my abilities.
Mentor Experience with the class	16	The peer mentors were a nice addition to the class. They were great for any questions I had throughout the course, especially when working on the final project. It was nice to have people close to my age helping me because they had been through the same class previously.
Provided Course Related Help	16	Peer mentors helped me out with any trouble that I had throughout the semester. Whenever I needed help with an assignment, I knew I could count on them to show me what to do.
Connect student with others/Making Personal Connections	13	It was refreshing to see a group of diverse people instead of the stereotypical white male engineering students.
Compassionate/ Empathy	4	Peer mentors made it easy to feel heard and understood by students who may have gone through similar issues or processes within their previous experiences.
Guided Learning	4	They helped explain things while encouraging me to try them myself.
Patient	2	They were helpful, patient, and knowledgeable. I felt like there was a space for me to learn.
Proactive	1	They were always ready to help when I asked them a question and even when I didn't have a question, they would check in and make sure our team didn't need anything.
Unavailable	1	The peer mentors made me feel at home however sometimes it felt like they were not coming around to ask us if we needed help enough. Sometimes when I would ask a question I felt like I was being a bother to the peer mentors and it made me feel like I did not belong in the classroom.

Working in Teams. Our second research question was, *How did the peer mentors influence the students' ability to work in teams effectively?* To answer this question, we examined the outcomes of the two selected response items aligned with working in teams. We found the students perceived the peer mentors positively influenced their ability to work in teams (see Figure 5), yet were more neutral toward their perceptions of the peer mentors helping resolve conflicts (see Figure 6).

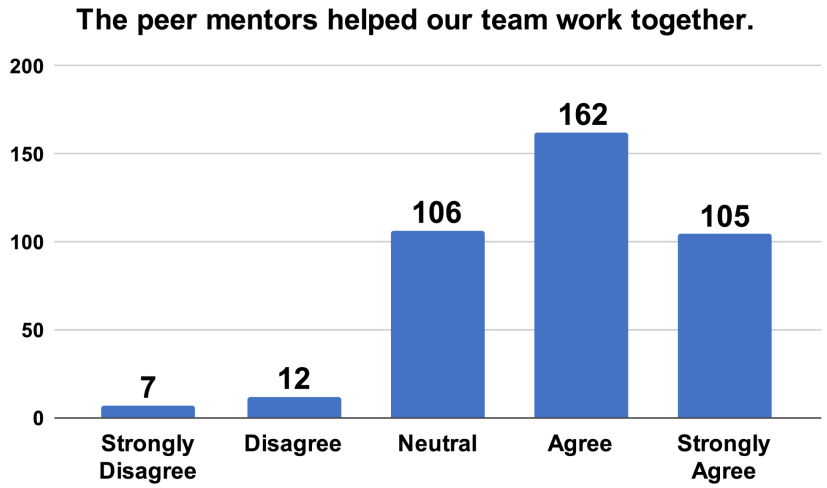

Figure 5: Likert frequency responses on peer mentor impact on teams of students together. Mean value of 3.88 (SD = 0.90) and median value of 4, for 1-5 weighing of likert scale.

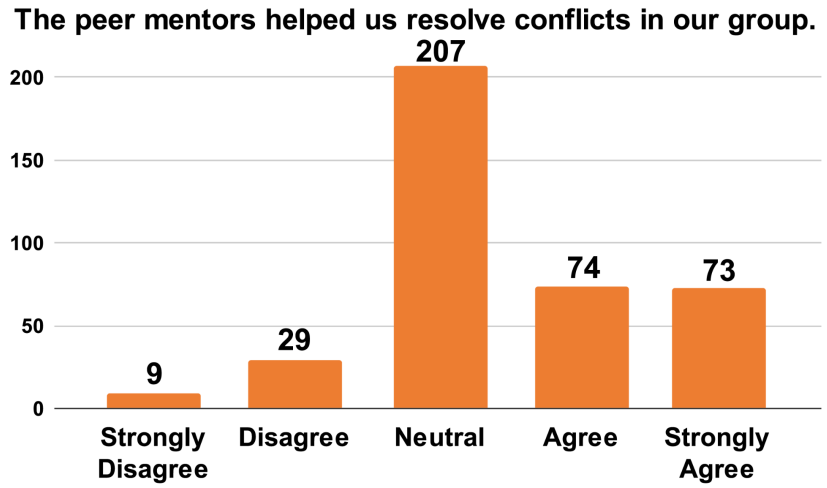

Figure 6: Likert frequency responses on peer mentor impact on group conflict resolution. Mean value of 3.44 (SD = 0.95) and median value of 3, for 1-5 weighing of likert scale.

We continued answering the research question by examining the coded data to our prompt, asking the participants to share how the peer mentors supported their teamwork. We examined the analysis outcome for frequency to determine the extent to which the students perceived the peer mentors influenced their ability to work in teams. We found the students tended to focus on the technical assistance provided by the peer mentors as influencing the student's abilities to function as a team (see Table 3). Again, we found about 15% of the students indicated that they did not perceive benefits from the peer mentors.

Table 3.

Code, Frequency, and Representative Statement(s) Associated with Students' Perceptions of Peer Mentors Supporting Team Function

Code	**N**	**Representative Response(s)**
Problem-Solving	74	When my team had an issue, the peer mentors would suggest a solution to the problem without entirely solving it. That room they left allowed us to collaborate to solve our problem.
Available/ Accessible	46	They asked us questions about how we were doing and always ensured we were helped.
Did not help students work as a group	44	The peer mentors did not specifically help my group to function as a team because my group was already functioning as a team, and we did not require that much assistance.
Technical assistance	41	They really helped us when we had trouble wiring our project. They sat and were patient to help us get our project working flawlessly.
No Interaction	37	We did not interact much with the peer mentors as a team, but we knew they were there if needed.
Group Instruction (technical)	28	They told us how to create solid models, and in turn we started collaborating on the whiteboard.
Gave Advice	27	They would often stop by and check on our project and offer advice whenever able. They also often stated how cool it was and seemed personally invested in our success.
Team Building	20	The peer mentors would help the team make consistent progress and encourage us to work together.
No Comment	20	N/A
Division of Labor	17	Peer mentors helped my team understand how to work together and how to divide up tasks and create good work.
Embraced Team Ideas	6	The peer mentors helped my group function as a team as they would help us bounce ideas off one another when it seemed like there wasn't a solution.

Demonstrate Processes	5	A peer mentor helped guide me through the process of 3D printing to the point where I was able to see and understand how easy it really was
Addressed the Group as a whole	5	They would make sure we all understood something when maybe only one person had a question.
Explained their Thinking When Offering Direction	3	They would help us with any issues we ran into and explain what went wrong, how they knew, and how to fix it in the future if that problem occurred again.
Understand College Structure	1	They helped inform us of each engineering major in a very concise and understandable way.

Confidence Development. Our third research question was, *How did the peer mentors influence the students' confidence development?* To answer this question, we examined the coded data to our prompt asking the participants to share how the peer mentors supported their confidence in their ability to do engineering. We examined the analysis outcome for frequency to determine the extent to which the students perceived the peer mentors may have influenced their engineering ability. We found the students perceived an array of interpersonal support from the peer mentors, such as fostering their learning, attending to their self-efficacy development, and being supportive and encouraging (see Table 4). Approximately 5% of the students indicated no perceived support for developing their confidence to do engineering.

Table 4.

Code, Frequency, and Representative Statement(s) Associated with Students' Perceptions of Peer Mentors Helping Them Develop Confidence to do Engineering

Code	**N**	**Representative Response(s)**
Fostering Learning	67	The peer mentors were there to clarify any challenges I encountered and get past those mental roadblocks, allowing me to keep learning.
Supporting Self-Efficacy	55	The peer mentors are examples of students that were once in my shoes and are now successful, thus increasing my confidence in my ability to do engineering.
Familiarity of the Space/Tools	48	They helped me to feel more comfortable with the technology and tools within the room.
Supportive	47	The peer mentors were supportive of our final project. A few came by and were really impressed.

Encouraging	34	The peer mentors gave words of encouragement and helped the team feel confident in our builds with words of affirmation and lots of help with tools.
Creating Common Identity	33	I developed confidence because I could see people who looked like me in a male-dominated field.
They Did Not	29	The peer mentors were not a factor in my confidence in my ability to do engineering
Limited to No Interaction	26	While I didn't regularly interact with the peer mentors, they set a good example for students
Building Self-Reliance	21	They allowed me to figure things out on my own in order to learn on my own. Being able to figure out my own projects gave me confidence in my ability to problem solve and work hard.
Growth Mindset	21	The peer mentors made me feel secure in the idea that making mistakes and slip-ups as an engineer is okay, as long as I keep working towards my goal.
N/A	21	N/A
No Conflicts	19	We did not have any conflicts in our group luckily.
Offered Explanations	18	By showing us how to do things and tasks we were uncomfortable with we were able to learn more about it and gain confidence and solve those problems on our own.
Predictable	7	The peer mentors' constant availability for guidance reinforces the idea that upperclassmen engineering students are trained in a manner that allows them to help others, even if their exact classes or disciplines are not the same as mine.

Recommendations for More Effective Peer Mentoring. Our fourth research question was, *What are students' recommendations for what peer mentors could do to foster the student community?* To answer this question, we examined the coded data to our prompt asking the participants to share how the peer mentors could help them feel more a part of the College of Engineering. We examined the analysis outcome for frequency to determine the extent to which the students perceived the peer mentors could increase their sense of belonging in the College of Engineering (see Table 5). We found the students were interested in learning more about clubs and activities, having more involvement and interactions with the peer mentors, and having more conversations about their peer mentor's campus experiences.

Table 5.

Code, Frequency, and Representative Statement(s) Associated with Students' Perceptions of how the Peer Mentors Could Help Them be part of the College of Engineering Community

Code	N	Representative Response(s)
Positive Statements of Current PM Support	108	I think the peer mentors successfully made me feel like I was an engineer.
No Need for Improvement	60	They were already good. I don't know what more they could have done.
N/A	44	N/A
Limited/No interaction	31	They did their work well, always there to help when you need it but I didn't interact much with them.
More information about clubs/activities/resources	21	I would have liked more information about their clubs and activities, they seemed interesting, but I forgot about them after the first mention. Mentioning subsequent meetings might have influenced me to go to one.
Share More Experience	20	Maybe if there was some sort of introduction activity where they talked about themselves and their experience in the College of Engineering.
Promptness/ Availability/ Accessibility	20	I would say maybe approaching the students more since they really only came around when prompted to.
Had no Impact	20	I don't feel that the peer mentors had much of an effect on my sense of belonging in the College of Engineering.
More Interactions	16	A little more class/personal interaction may have helped create more dialogue and a better sense of community.
More conversations unrelated to project/task -deeper connection	14	The peer mentors could have helped me feel more like a part of the college of engineering community would be to introduce themselves more fully and go over their specialties in more detail so that we could identify more with them and ask questions about their college experience.
More Involved	13	During the peer mentor hours, if they could have walked around a little more and talked about more than just the assignments or class, I think it would have helped us get to know them better.
Share More Advice	13	I would have liked to talk to them more about their specific engineering journeys and any advice they had for first-year students.
More Interactive Activities	5	We could have been more involved in activities with the peer mentors. I think that such activities will help students build stronger interactions with them.

Feedback	5	They could have given advice on ideas and how to improve upon them.
Peer Identification	3	It was challenging to tell peer mentors from other students needing help. I believe that some kind of badge or other identification would help me ask for help.
Workshops	3	Hosting workshops in the classroom on certain subjects outside of the class, such as soldering, could lead to more involvement with peer mentors.
Tool/ Equipment Use	1	They gave us access to things like 3D printing and soldering
Comfort with the space	1	By opening up the space for me to work on my engineering projects, even when unrelated to this class

Discussion and Implications

Sense of Belonging. We found overall, the students perceived the mentors enhanced their sense of belonging. We speculate this is due to selecting students with positive attitudes and who work well with others to be peer mentors. Further, we also posit that the diversity among the peer mentors expands the likelihood the students will be able to interact with mentors they can identify with (e.g., female, a person of color). Positive interactions with the peer mentors and interacting with peer mentors with a similar identity expands the potential for students to experience a great sense of belonging. Attending to students' sense of belonging is critical to their development and is associated with student persistence and engagement in learning. Thus, enhancing the peer mentors fostering of student belonging is fundamental to student success. In future research, we plan to explore in more detail how to enhance the peer mentors' awareness of their influence on student belonging and what they can do to enhance belonging.

Working in Teams. Our research empirically documented students perceiving the peer mentors as effectively facilitating their working in teams in several ways, including, through technical assistance and encouraging the division of labor. The student's perceptions of the peer mentors as present and approachable indicates they have a beneficial disposition to facilitate team interactions. Teamwork is critical to effective engineering, and therefore, working to increase the peer mentors' effectiveness in fostering teamwork will impact the students' long-term professional success. While the peer mentors are familiar with teamwork and have some skills for facilitating team learning, we speculate mentors may be much more effective with more formal preparation. Thus, in our future research, we plan to explore how professional development of the peer mentors may influence their success and impact when facilitating students working in teams.

Confidence Development. Our findings suggest that the peer mentors tended to support student confidence development through interactions that increased the students' technical skills. The support of technical knowledge acquisition seemed to be associated with the mentors' positive disposition (i.e., approachable, supportive). As several students shared responses aligned with developing self-efficacy, there is a need to ensure peer mentors are prepared with the knowledge and skills to support student confidence development. Developing self-efficacy is aligned with the vector developing personal competence [1]. Thus, efforts to enhance the students' confidence are fundamental to their overall personal and professional development, which appears to be influenced by the peer mentors. In our future research, we will explore how different professional development opportunities for the peer mentors may affect their effectiveness in increasing students' confidence development.

Recommendations for More Effective Peer Mentoring. Our research question about recommendations for more effective peer mentors was challenging to answer because many of the participating students provided responses that were not suggestions. We speculate the students either had nothing to contribute, or they did not correctly read the prompt. Regardless, the student recommendations we found were aligned with suggestions of more personal interactions and more shared personal educational experiences. Our analysis suggested the students were seeking advice and knowledge they could apply to navigate their college experience. Researching what students want or expect from peer mentors in more depth may be fundamental to understanding what is needed to prepare the mentors to be more effective. To date, our very limited professional preparation of peer mentors has focused on technical knowledge (e.g., how to use equipment in the makerspace) and communication skills to help peer mentors to assist students with their projects. However, we recognize the need to expand their preparation to focus on facilitating the first-year students' success on multiple levels, which may involve sharing more personal experiences.

Limitations and Delimitations

Our first delimitation was we did not collect data from the peer mentors to determine if their perceptions aligned with the students. We chose not to do this because of the added complexity. However, we have a plan to continue our research with a focus on collecting a range of data from the peer mentors.

Our second delimitation was a decision to collect data for only one fall semester. It may be possible that students' experiences in the spring and summer semesters are different. Our future research involves multiple rounds of data collection across multiple semesters to determine if the perceptions and interactions with the peer mentors change based on the time of year.

Our third delimitation was the lack of knowledge of which mentor(s) the students were thinking of when they completed the surveys. We chose not to have the peer mentors identified based on the desire to remove potential issues of trust or honesty. However, in our future research, we plan to observe the peer mentors facilitating student learning and will be identifying the mentors. In reporting our results, we will de-identify data and assure confidentiality by reporting results in aggregate.

Our first limitation was our lack of knowledge about whether the students were considering the mentors in their regularly scheduled course or the mentors they interacted with in the makerspace after hours during drop-in times. In our ongoing research, we recognize the need to distinguish between these two conditions as the structure of these situations differs, and the interactions with the peer mentors may also differ.

Our second limitation was our lack of knowledge about the alignment of individual perspectives compared to the team perspectives of the peer mentors. While we recognize now the difference could exist, we did not anticipate how the different views may influence how the students answered.

Our third limitation was the potential of our survey structure to have limited student responses and their perceptions. We anticipated they would share freely beyond the scope of the prompts, which they did. However, they seemed to have misunderstood some prompts and provided irrelevant responses to our research focus. We will continue to refine our research tools and data collection to ensure capturing a diversity of perspectives.

Conclusion

Our exploratory research into the impact of peer mentors facilitating first-year student learning in an engineering program maker-space course revealed mentor personality, disposition, and knowledge are critical to meeting student needs. We found peer mentors can positively influence student progression in multiple growth vectors, thus, are instrumental in the students' development.

Our findings also provide insight into additional areas of needs of students for learning support and how peer mentors can more effectively facilitate learning. We will use the results to create a professional development course for our mentors to prepare them to be highly effective at facilitating students' learning in the makerspace. Thus, our future research will attend to the questions that our research exposed and our desire to refine and increase the effectiveness of the peer mentoring program.

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