

The Benefit of Student Peer Mentors to Engineering Faculty Members Teaching in a Makerspace Classroom (NSF-IUSE)

Dr. Louis S. Nadelson, University of Central Arkansas

Louis S. Nadelson has a BS from Colorado State University, a BA from the Evergreen State College, a MEd from Western Washington University, and a PhD in educational psychology from UNLV. His scholarly interests include all areas of STEM teaching and learning.

Dr. Pamela L Dickrell, University of Florida

Dr. Pamela Dickrell is the Associate Dean of Student Affairs in the UF Herbert Wertheim College of Engineering.

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Intro duction

Adopting the flipped classroom model, we have integrated peer mentors into a first-year engineering design course taught in a makerspace classroom. The peer mentors have become an integral part of the course. Of interest to us in this research project was the impact that the peer mentors have on the faculty members teaching the course. Thus, we sought to empirically document faculty members' interactions, expectations, and impressions of having peer mentors in their highly interactive design course. Before we present our findings, we review some of the relevant research to provide context and justification for our research.

Literature Review

Peer mentoring for undergraduate college students can take place in many forms. These include peers acting as tutors in drop-in learning support centers on college campuses, such as a writing center or quantitative reasoning/mathematics center (Carino, 2003). The support provided by peer tutors may also take a non-place-based approach, with peer tutors available during scheduled online structured or drop-in tutoring sessions. Peer tutors may be integrated into class meetings to support instruction as it takes place, as is the case with the learning assistant (Wilson & Arendale, 2001) and supplemental instruction (Dawson et al., 2014) programs. Common to these forms of peer support is the frequent focus on helping students solve problems with known solutions.

Peer mentors in makerspaces are not unique (Davishahl et al., 2022). However, what is unique to our makerspace-based peer mentoring program is that it takes place in a makerspace classroom that is used in the instruction of a first-year design course for engineering majors (Nadelson et al., 2024; Nadelson & Dickrel, 2025). A portion of the course involves guided instruction to provide the students with foundational knowledge for exploration. In addition, the curriculum includes a culminating design project that engages students to work in small groups to apply the knowledge they have gained in the course. The project requires students to design and prototype a product that meets a set of criteria and constraints, allowing for a broad range of creative and unique products.

The courses are led by engineering faculty members and typically have around 49 students in a section. Given the challenges with providing support for 49 first-year engineering students engaged in hands-on, minds-on learning activities, peer mentors are hired to provide learning support in each section of the course. Further, the course has drop-in learning opportunities that are fully staffed by the peer mentors.

We have researched the impact of the peer mentors on the students in the course and the impact of being a peer mentor on the professional development of the peer mentors. In this project, we explored faculty members' perceptions of the benefits and challenges of having peer mentors associated with the courses.

Methods

Research Question. Our primary research question for our project was, what are faculty members' experiences, expectations, challenges, and successes working with peer mentors in a first-year design course taking place in a makerspace classroom? To more effectively answer this question, we developed the following guiding research questions:

- a. What are your expectations of the peer mentors assigned to your course?

- b. What are the challenges of working with peer mentors?
- c. When are peer mentors most effective?
- d. When are peer mentors least effective?
- e. What additional support could peer mentors provide?
- f. What have you learned from working with peer mentors?

Participants. The participants in our study were five faculty members who taught a first-year design course in the College of Engineering at a large public university in the southeastern region of the United States. All held graduate degrees in engineering and were affiliated with a department of engineering education. Participants' experience teaching the course ranged from one to seven years, and all had taught it for at least 3 semesters. Additionally, the faculty members were teaching other engineering courses.

Methodology. We determined that a qualitative methodology would be most effective due to our limited sample size and the unique context for the sources of data (the first-year engineering design course and working with undergraduate peer mentors). Thus, we embraced a case study approach to our design and analysis.

Data Collection. Given our desire for a qualitative approach. We developed an interview protocol with prompts such as, "How do you interact with the peer mentors?" and "What are your expectations of the peer mentors?" and "What have you learned from the peer mentors?" Each interview lasted about 20 minutes and was recorded and transcribed for analysis. Using a semi-structured approach, we interviewed course instructors to document their experiences and thoughts about having peer mentors working with them to support student learning in their courses.

Data Analysis. To analyze our data using content analysis (Creswell & Plano Clark, 2011). Thus, we examined the responses for the five most prevalent themes based on the interview prompt. For example, an examination of the responses to our interview prompt focused on the major challenges with teaching the design class we exposed themes of variability in student knowledge and capacity and managing student team dynamics.

Trustworthiness. To maintain the trustworthiness of our research, we created and used an interview protocol that allowed us to be consistent in our data collection. We recorded the interviews, which allowed for verbatim transcription from audio to text, enhancing the accuracy of the participants' responses. We also maintained consistency in our analysis by locating specific quotes, which we used to substantiate our themes.

Results

Interaction with Peer Mentors. We began our research on the faculty members' work with the peer mentors by asking them to share how they interact with the mentors. Our analysis exposed a theme of trust and rapport as exemplified by the following response, "I always go to my classes a little earlier... I just chat with them and check in on how things are going." The participants also indicated the peer mentors acted as informants of the students' perspectives. One participant commented, "They can see things from a student's perspective that are much more obvious to them than to me." Thus, the interactions tend to be collaborative and cooperative, with the faculty members working with the peer mentors as a team.

Expectations of Peer Mentors. We found the participants consistently shared responses associated with expecting the peer mentors to act professionally and see the classroom as their workplace as exemplified by the following quote, "This is a job, so they should be here on

time—I don't want them coming in and disrupting the class.” The participants also recognized that the professional development of the peer mentors is ongoing, as one participant shared, “Nobody comes all seasoned and perfect... it takes a few semesters for them to get there.” The faculty members noted that there was a need to maintain both trust and boundaries with the peer mentors, as one faculty member stated, “Even if they're seasoned, I still have to set some boundaries so they stay focused on the classroom.”

Peer Mentors Most Effective. In our analysis of the responses to our interview prompt focused on the faculty members' perspective of when the peer mentors were most effective, we found they perceived mentoring motivation as fundamental to effectiveness. As one faculty member stated, “There are some peer mentors where you don't have to say anything—they walk around, get the grading done, they're on point.” The faculty members also recognized the need to provide the peer mentors with directions and expectations, and then letting them engage in the tasks as apparent in the following response, “I show them how I grade... here's the rubric, here's how you use it, so they understand my expectations.” The faculty members recognized the peer mentors as being highly effective in one-on-one or small group support, as one faculty member stated, “They're most effective when they're working one-on-one with students or student teams.”

Peer Mentors Least Effective. In our examination of the responses to our prompt asking the faculty members to share when the peer mentors were least effective, the participants identified the need for ongoing guidance as reflected in the following response, “When we don't give them guidance, and we let them just be whatever, you can totally see [their effectiveness] going down.” Several participants indicated the peer mentors were not being effectively engaged early in the course when the teaching format tends to be dominated by lecture. As one participant replied, “The first two or three weeks are more lecture-heavy, and that's when they're the least useful.”

Additional Support Peer Mentors Could Provide. The faculty members indicated the peer mentors could be more supportive when they recognize the need to distribute their time among many students. One participant commented, “There's a time-limiting factor here—we can't spend the entire class on one student's device.” The faculty members also recognized the peer mentors are more likely to be approached by students for support, as indicated by the response, “Sometimes they explain things in a way students feel more comfortable asking questions, because they speak the same language.” The faculty members all held perspectives aligned with the following statement, “If they could come to class and just know how to support the faculty and the students without me micromanaging, they're very effective.” Thus, preparing peer mentors before they assume their roles seems critical to extending the level of support they can provide.

Learned from Working with Peer Mentors. Our final focus was on what the faculty members learned from working with the peer mentors. The participants shared how working with the peer mentors increased their instructional insight as reflected in the response, “They tell me things I don't know—like if I'm going too fast or too slow—and I'm constantly learning from them.” The faculty members also indicated they are learning additional leadership skills due to work with the peer mentors. As one participant stated, “Working with peer mentors is like working in a small company—I've learned people management skills.” The learning could be effectively summed by the following response, “Every interaction with them is something I'm gaining to be a better faculty member in the future.”

Discussion

The goal of our research was to explore different facets of faculty members' perspectives and experiences working with peer mentors in a first-year design course held in a makerspace classroom. The faculty members held very consistent perspectives and shared similar experiences. Their interview responses have several implications for practice, including the development of peer mentors and faculty members.

Our research provided further evidence of the importance of preparing peer mentors to support student learning in the course, but also the importance of preparing peer mentors to work effectively with the faculty members teaching the course. The results of our research will be used to further refine our peer mentors' preparation course, particularly what to do and not do as peer mentors, and the importance of attending to the direction and needs of the faculty member leading the course.

The participants stressed the need for and benefit to having the peer mentors take initiative, but also balance their focus to be supportive of many students rather than focusing on the needs of just a very limited few. We suspect activities with role playing and discussions of scenarios are likely to be most effective for helping prepare the mentors for balancing their peer support and while taking initiative.

Similar to meeting the needs of the peer mentors through a professional development course, our results indicate that the faculty members could also benefit from professional development to prepare them for working with the peer mentors. While such an offering would be much abbreviated compared to the course for the peer mentors, our research revealed the need to prepare the faculty members to work with the peer mentors to maximize the benefit of having the students as instructional collaborators.

Limitations. The primary limitation of our research is the limited sample size. We only interviewed five faculty members. However, there were only seven faculty members teaching the course, so it may be difficult to determine the potential contribution two more faculty members could have made in our findings. Furthermore, we did find a high level of consistency in the participants' responses, indicating our data were likely highly representative of the population of faculty members teaching the course and working with the peer mentors.

The second limitation is we gathered the data through interviews and did not triangulate the responses with observations of the interactions between the peer mentors and the faculty members. Future research should include a diversity of data collection to triangulate the responses of the faculty members with other sources of data.

Conclusion

Our research on the experiences, expectations, gains, and struggles of faculty working with peer mentors in a first-year design course taking place in a makerspace classroom revealed several salient findings. While there is an expectation for peer mentors to impact the learning of the students, rarely is there a consideration of how peer mentors may be impacting the faculty members they are working with. Our research addressed this gap and revealed a range of benefits and some challenges. We conclude that additional preparation for both the peer mentors and the faculty members will better position them to be highly effective in working together to enhance the learning of the students in the course and be more efficient in the course organization and implementation.

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