BOARD # 268: Mentoring You Supports My Development as a Professional Engineer: How Peer Mentors Benefit from Mentoring Peers

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 lear

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.

Mentoring You Supports My Development as a Professional Engineer: How Peer Mentors Benefit from Mentoring Peers

Introduction

Peer mentoring programs have become common on college campuses. Frequently, peer mentors are hired to work in writing centers or math learning centers to tutor students on learning and completing assignments. Peer mentors have also been integrated into courses such as with the Learning Assistant (Barrasso & Spilios, 2021) and Supplemental Instruction (Dawson et al., 2014) programs. It is also common for peer mentors to be involved in laboratory courses such as chemistry (Damkaci et al., 2017) and physics (Rehse et al., 2020). More recently, peer mentors are being hired to provide support in university-based makerspaces to help students working in the space complete assignments or accomplish their personal goals. Similarly, in exploring the potential positive impact of peer mentors, Davishahl et al. (2022) explored the placement of peer mentors in roles as Student Engagement Liaisons to support other students in formal and informal situations to enhance their general engagement and learning success. These research studies have focused primarily on the impact of the peer mentors on the success of the students they are mentoring rather than the impact on the students in the role of peer mentors. To address a gap in the literature, we explored how being a peer mentor in a first-year engineering design course taking place in a makerspace classroom impacted the mentors' professional development, personal growth, and academic success.

Peer Mentors and First-Year Design Course

Unique to our program is hiring peer mentors (who are engineering majors) to support engineering students enrolled in a first-year design course taking place in a makerspace classroom (Dickrell et al., 2024). The course is structured to meet once a week for two hours. The typical course has 49 students enrolled and is led by a single instructor who is a member of the university engineering faculty. Thus, the student-to-faculty ratio in the space is 49 to 1. In the course, students work in small groups (usually four students) as they engage in assignments designed to help increase their knowledge of engineering. Some of the activities are scripted (e.g., circuit building), while others require the students to design and prototype a product following general guidelines. Thus, the students learn about engineering through design, prototyping, testing, refining, rebuilding, and retesting.

Given the high level of student engagement in activities in the course that they may not be familiar with (e.g., building prototype circuits using breadboards, using power tools), there is a need for additional learning support beyond what a single instructor can provide. Thus, the college hires a cadre of peer mentors (also undergraduate engineering students) to work with the students in the courses and support students in the makerspace classroom during open classroom hours. The integration of peer mentors into the course has been taking place for several years. We are working with 15 undergraduate engineering majors this semester, preparing them to be peer mentors and researching how their mentoring experiences are influencing their professional development.

A Gap in the Research

We recognize the potential for mentoring to benefit the mentors (Nadelson & Finnegan, 2014; Smith & Nadelson, 2016). However, there is a gap in the research detailing how peer mentors working with students in makerspace classrooms in undergraduate engineering may enhance their perceptions and knowledge of themselves as both professionals and engineers. Thus, there

is justification for examining the impact of mentoring on the peer mentors' development as professionals and engineers.

Method

Research Question

We used the following question to guide our research: How does engaging as a peer mentor impact the mentors' development as engineers and professionals? Our guiding research questions were:

1. What was the motivation to be a peer mentor?
2. How were the mentors prepared to be mentors?
3. What did they perceive to be highly effective and successful mentoring?
4. What challenges did the mentors perceive they encountered in their mentoring role?
5. How did mentoring influence their personal growth?
6. How did mentoring influence their professional growth?

Participants

The fourteen participants in our research were undergraduate engineering majors students acting as peer mentors in a first-year design course being taught in a makerspace classroom. Their semesters of experience as peer mentors in the program ranged from one semester to eight semesters. There were eight females, six males, and one student who identified as non-binary. The students were majoring in mechanical engineering, computer engineering, civil engineering, and electrical engineering.

Interview Protocol

We also developed an interview protocol to gather the narrative of the peer mentors to empirically document their lived experiences as mentors and the impact their mentoring experiences have on their professional and engineering identity development. We examined the outcome of related research (e.g., Nadelson et al., 2017; Villanueva & Nadelson, 2017) and considered our research questions as we developed the eleven prompts in our protocol. The prompts included questions such as "Why did you want to become a peer mentor?" and "What are you learning about yourself through peer mentoring?" and "What are you learning about engineering through peer mentoring?" and "How is being a peer mentor influencing other parts of your life?"

Data Collection

We gathered data from the peer mentors using semi-structured interviews. We interviewed the students in small groups or individually. We followed the basic structure of our protocol yet left open the opportunity to ask clarifying questions or additional questions based on the participant's responses. The interviews took approximately 30 minutes and were digitally recorded. Following the interviews, we transcribed the recordings using an online transcription service (Temi.com).

Data Analysis

To analyze our data, we used both inductive and deductive coding. For our deductive coding, we developed a set of a priori codes based on the literature and our experience working with peer mentors. For our inductive coding, we developed codes based on ideas from the data that aligned with our themes. See Table 1 for our analysis themes and codes.

Table 1. Themes and Codes for Analysis

Theme	Emergent and A priori Codes
Why Pursue a Peer Mentor Position	enjoyed class, the professor, the opportunity to learn, knew other peer mentors, the community, affinity for being a mentor
Professional Preparation	prior experience helping others, summer camps, tutoring, club involvement, class expectation, working with an instructor
Effective Mentoring	Let students do, don't take over, notice student engagement, knowing personal limits of knowledge, noticing struggling learners,
Personal Growth	Confidence, talking to people (communication), community, more outgoing, campus and beyond opportunities, humility, comfort not knowing
Professional Growth	Asking for help, admitting you don't know, increased technical knowledge, facilitating group, technical communication, communicating in multiple ways, asking questions, facilitating (instead of doing), working as a team for support, knowing strengths, knowing limits, the benefit of teamwork, effective teaching
Successes	Inspiring others, seeing students learn
Challenges	Not knowing technical content, self-confidence (imposter syndrome), time, communicating with some students, risk-taking, being able to help all those that need help, students closed to mentoring when they need it, Students unwilling to learn from mistakes, Students with fixed mindset, challenging personalities
Needs	More technical knowledge, troubleshooting knowledge, understanding how people learn, how to facilitate student learning, how to facilitate teams/collaboration

Trustworthiness

We took multiple steps to enhance the trustworthiness of our research. To strengthen our research dependability, we developed an interview protocol, enhancing the opportunity for data collection consistency and study replication. We established confirmability through personal interviews of our participants, recording the interviews when participants gave permission, and followed up with clarifying questions when necessary. To bolster the transferability of our research we provide a list of the codes (both a priori and emergent) so that others may be able to replicate our analysis process. To increase the credibility of our research, we gathered data from a diversity of qualifying participants, allowing for personal differences to be recognized as a potential influence on the responses while seeking to expose consistency in the data.

Results

For our first guiding research question, What was the motivation to be a peer mentor? We found the participants were motivated to become mentors due to the positive experiences they had in the course as students. They indicated they had positive interactions with the mentors and faculty

members, which motivated them to want to become meteors. Many of the participants also indicated they enjoyed mentoring as an increased opportunity for learning.

For our second guiding research question, How were the mentors prepared to be mentors? Our data indicated some participants had prior experience as mentors which partially prepared them to be mentors in the design course. All indicated they were learning to mentor through experience and observing other mentors with more experience mentoring.

For our third guiding research question, What did they perceive to be highly effective and successful mentoring? We found the mentors perceived successful mentoring to be when they guided the students and let the students do the work. They also indicated successful mentoring was when they noticed struggling students and provided support from the side rather than taking over the process and simply completing the task for the students.

For our fourth guiding research question, What challenges did the mentors perceive they encountered in their mentoring role? The data indicated the mentors were most frequently challenged due to their limited technical knowledge. They also were changed by the mindset of the students they were mentoring, particularly the fixed mindset of students and challenging personalities.

For our fifth guiding research question, How did mentoring influence their personal growth? The participants overwhelmingly indicated that the mentoring program helped them increase their technical knowledge and skills. They shared how mentoring helped them be more outgoing and work with a wide range of personalities. The mentors also shared that the experience was humbling at times when students would ask for help, and the mentors did not have the knowledge to provide the needed support and had to rely on other mentors to respond to the student's requests for support.

For our sixth guiding research question, How did mentoring influence their professional growth? Our analysis revealed considerable overlap between the mentors' perceptions of their personal and professional development, sharing they gained more technical knowledge, learned to work with challenging personalities, gained knowledge of how to facilitate group interactions, and developed advanced problem-solving skills.

Discussion and Implications

Our research empirically documented a range of positive outcomes for students engaging as peer mentors in the unique environment of a first-year design course as the course was being taught. The unique environment afforded the students in roles as peer mentors to learn more about themselves as professionals and their personal strengths and weaknesses. Through the experience, the peer mentors gained a number of technical skills, professional engineering knowledge, and developed more advanced social skills. We speculate that the unique learning environment of the makerspace and the unique learning situation of engaging in engineering design advanced opportunities for the peer mentors to develop professionally and personally in ways that would be much more effortful in more traditional settings and in more conventional course formats. Our future research will involve researching the professional outcomes of peer mentors who graduated to determine if the outcomes of being a peer mentor have a longitudinal influence.

Acknowledgments

This material is based upon work supported by the National Science Foundation, IUSE Improving Undergraduate STEM Education under Award Nos. 2315229 and 2315230. Any opinions, findings, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

References

Barrasso, A. P., & Spilios, K. E. (2021). A scoping review of literature assessing the impact of the learning assistant model. International Journal of STEM Education, 8, 1-18.

Dawson, P., van der Meer, J., Skalicky, J., & Cowley, K. (2014). On the effectiveness of supplemental instruction: A systematic review of supplemental instruction and peer-assisted study sessions literature between 2001 and 2010. Review of educational research, 84(4), 609-639.

Damkaci, F., Braun, T. F., & Gublo, K. (2017). Peer mentor program for the general chemistry laboratory designed to improve undergraduate STEM retention. Journal of Chemical Education, 94(12), 1873-1880.

Davishahl, J., Boklage, A., & Andrews, M. (2022, August). Peer mentors forging a path in changing times. In 2022 ASEE Annual Conference & Exposition.

Dickrell, P. L., Virguez, L., & Goncher, A. (2020, June). Structure of a human-centered and societal-based first-year maker space design course. In 2020 ASEE Virtual Annual Conference Content Access.

Dickrell, P. L., Virguez, L., & Goncher, A. (2020, June). Structure of a human-centered and societal-based first-year maker space design course. In 2020 ASEE Virtual Annual Conference Content Access.

Nadelson, L. S., & Fannigan, J. (2014). Path less traveled: Fostering STEM majors' professional identity development through engagement as STEM learning assistants. Journal of Higher Education Theory & Practice, 14(5).

Nadelson, L. S., McGuire, S. P., Davis, K. A., Farid, A., Hardy, K. K., Hsu, Y. C., ... & Wang, S. (2017). Am I a STEM professional? Documenting STEM student professional identity development. Studies in Higher Education, 42(4), 701-720.

Rehse, S., Tieu, A., Ibrahim, S., & Kotevski, V. (2020). Creation of an undergraduate peer mentorship program for first-year physics labs. Conference paper, *UWill Discover, 2020*.

Smith, J., & Nadelson, L. (2016). Learning for you and learning for me: Mentoring as professional development for mentor teachers. *Mentoring & Tutoring: Partnership in Learning*, 24(1), 59-72.

Villanueva, I., & Nadelson, L. (2017). Are we preparing our students to become engineers of the future or the past. International Journal of Engineering Education, 33(2), 639-652.