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Unanticipated Outcomes: Social and Academic Benefits for STEM Peer Mentors

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Abstract

This practice paper will present the findings of qualitative assessment conducted on undergraduate participants in a peer mentoring program in the College of Engineering at a large public university. Past research mostly focuses on the effects of mentoring programs on the protégés–those who benefit from being mentored. With the increase of leadership and peer mentoring programs across universities [1], it's important to examine all aspects and impacts of these programs on all students served. Over several years, it became apparent that the mentoring program had quite a positive effect on the mentors themselves as well as the protégés. Intrigued by higher graduation rates of former peer mentors, the researchers sought to discover and examine the academic and social benefits peer mentors found by participating in this program. A random number generator was used to select twenty people from a list of all mentors who served at least two years in the program (n=101) since 2010. Many of these mentors had graduated and worked in various engineering positions, while others were current students. Phone interviews of eight current and former mentors were conducted by a researcher outside of the program, and their identities were not shared with this researcher. All interviews were transcribed by a third party, and they were coded using Tesch's eight steps for coding qualitative data [2]. Themes that emerged were validated using member checking to ensure that the participants agreed with the conclusions [3]. Three main themes emerged from these interviews: development of leadership and communication skills, improved sense of community, and increase in motivation. Information gathered from these interviews suggest that participation as a mentor was academically enriching, ensuring the mentors' own academic persistence, as well as socially beneficial, with the program serving as a springboard for other leadership opportunities within the college and larger university. Gathering data on the effects of peer mentoring programs on the mentors themselves can help to solidify new mentoring programs and to inform well-established programs of patterns and benefits of which administration may not already be aware.

Introduction

For the past three decades, peer mentoring has been a buzzword in higher education. Programs have been established to address retention and student success in response to a national need for STEM graduates to advance innovation [4]. Jacobi [5] summarized the 15 definitions of mentoring prevalent in the early 1990s. She identified three components of the mentoring relationship found within the definitions at the time: emotional and psychological support; direct assistance with career and professional development; and role modeling. In academic support for STEM majors, peer mentoring has often referred to upper-year students serving as academic social role models for lower-year students. For the purpose of this study "peer mentoring" and subsequently "peer mentor(s)" will refer to year 2-6 students who lead first-year students in pre-college engineering camps, serve as Supplemental Instructors in historically challenging courses in engineering, conduct community outreach events, and assist first-year students with scheduling their courses [6].

Crisp and Cruz [7], and Kiyama and Luca [8] contend that there is a gap in the literature on the experience of mentors. In Crisp and Cruz's survey of 42 empirical studies written between 1990 and 2007, only two were through the lens of the mentor. There is also a need for qualitative research on STEM peer mentoring because much of the literature on STEM peer mentors is quantitative in nature.

The literature is replete with quantitative evidence that peer mentoring programs are effective in the retention of college students. Holland, Major, and Orvis [4] tested for peer mentoring as positively related to satisfaction with major, affective commitment to major, involvement with major, and willingness to mentor others. Their study surveyed 214 STEM students at a primarily white institution and a historically black institution. The hypothesis was confirmed. The literature also indicates that peer mentoring has had a positive effect on underrepresented students in STEM. Good, Halpin, and Halpin [9], in a study of 19 African American engineering peer mentors, found that mentoring lower-year students provided underrepresented mentors themselves with the opportunity for academic growth, improved their interpersonal skills, and enhanced their grades and retention rate at a major southeastern university. Their study, qualitative in design, studied the journals of minority peer mentors as they noted their experiences from prompts they were required to answer. Similarly, Washburn and Miller [10], in a mixed-methods study of 51 STEM students at Purdue University, identified a formal peer mentoring program for the school as a student-generated strategy for combatting declining female student enrollment and a poor retention rate. The study relied upon a survey of members of a student organization, Women in Technology, for data. Open-ended questions were included.

Brand and Kasarda [11] studied female students enrolled in a high school robotics program and at an all-women's college, to determine the influence of social interactions on female engineering students. Encouraging female students to experiment with engineering in a collaborative environment was a goal for both programs. The qualitative study was conducted within a socio-cultural framework, assuming that individuals learn from communicating with one another and that interaction results in collective understanding. 22 participants, 6 from the high school and 16 from the college, attended small-group interviews in which a semi-structured protocol used open-ended questions to get students to describe the factors that were significant to their learning. Students indicated that verbal and non-verbal support, from faculty and other students, was critical to their success. They also indicated that collaborative group work was meaningful and supportive, as well as motivating and reinforcing.

Kiyama and Luca [8], in a study of peer mentors for a six-week transition camp, found a number of positive emergent themes. Using a qualitative design, 48 peer mentors were invited to participate in two phases. 25 completed phase one, 22 phase two. The first phase was a series of online essays, providing the researchers narratives from three questions regarding their own transition into college, their role as a peer mentor, and the role of retention initiatives. The second phase was a series of group interviews with four to seven participants engaging in a sense making session on their collective experience. The authors found a number of positive themes emergent in their two-phase study. Peer mentors mentioned that serving as a mentor provides them with a structure of opportunity, specifically that they gained a sense of identity and developed group norms. The participants mentioned a sense of community, in which mentors, in

addition to developing lower-year students, helped one another's student development. This also led to new social opportunities. The peer mentor group provided a network, including support and career direction for mentors. Finally, and perhaps most important in the study, similar to Good, Halpin, and Halpin [9], the results included the benefit of a peer mentoring program on mentors' retention.

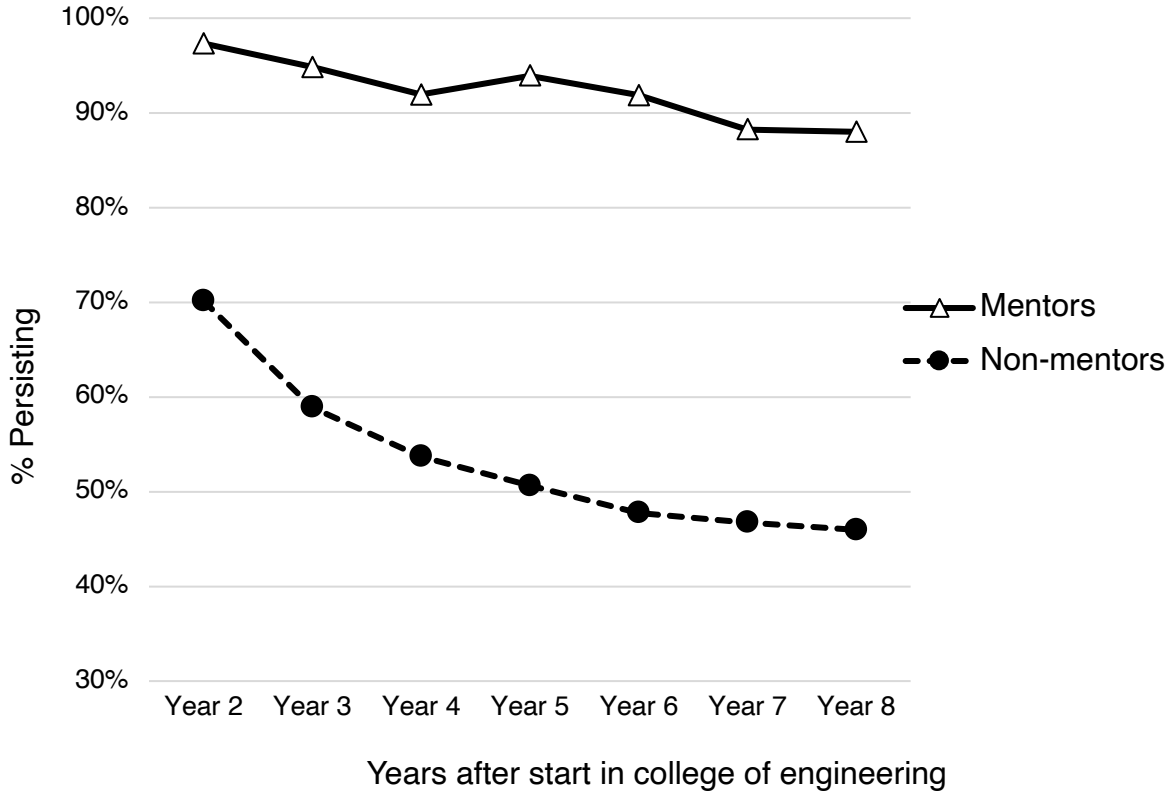
Background and Peer Mentor Program History

The peer mentoring program in the College of Engineering at Louisiana State University began with the receipt of an NSF STEM Talent Expansion Program (STEP) grant in 2007; a STEP 1B grant was awarded to the college in 2013 to continue and expand these activities. The first 2-3 mentors assisted with the inaugural Encounter Engineering Bridge Camp (E^2) for entering freshmen and with a rejuvenated introduction to engineering course (ENGR 1050). By 2012, the program had grown so large that the mentors sought to form their own student organization, the Society of Peer Mentors (SPM), to work closely with project staff [6]. SPM had 170 active mentors in 2019 who continue to serve as leaders in the freshmen bridge camp, help with the ENGR 1050 course, perform over 100 hours of K-12 outreach per year, mentor robotics teams in local K-12 schools, and work as Supplemental Instructors. The organization has been growing every year, with 211 members inducted in 2020. Understanding the benefits of active engagement, the SPM officers developed a point system to quantify the mentors' involvement. It is also used as an accountability measure for those seeking SPM leadership positions, wanting funding to develop a new initiative, and/or simply seeking to earn recognition at graduation with university approved honor cords. Peer mentors are also required to participate in two full-day leadership workshops offered each spring. After being an active mentor for two years or more, most move up to "leader" status within the organization hierarchy. Leaders are given much more responsibility, such as assisting with the planning of the leadership workshops and presenting at conferences. These leaders play an integral role in developing the new mentors who join the organization, mentoring the mentors themselves.

A few methods to analyze the effectiveness of the peer mentor program at LSU have been undertaken recently [12], [13]. In 2014, an outside evaluator conducted focus groups with 12 participants. These students showed enthusiasm for the program, found value in the opportunities for them to get hands-on leadership and communication experience, and indicated a sense of community they felt through their participation. Additionally, analyses of retention and graduation rates in the college show that mentors persist in engineering at a much higher rate than non-mentors with an 8-year figure of 88% compared to 46% for non-mentors (Fig. 1).

Upon reading the Kiyama and Luca study [8], some in the college of engineering wondered what academic and social benefits our peer mentors credit the program with providing. Tinto [14] found that there is significant interplay, formal and informal, between the social and academic sides of a university campus. In his theory of student college persistence, a student who engages both academically and socially is more likely to persist in completing their degree, and one who lacks either kind of engagement, whether academic or social, is less likely to persist. To ensure student persistence, Tinto proposed that students be integrated in the academic and social communities of the institution.

Figure 1. Comparison of the persistence in LSU's College of Engineering of peer mentors vs. non-mentors from 2006-2015 cohorts.



Methods

The SPM staff advisor compiled a list of all peer mentors who served at least two years as a mentor in the program from 2010-2016 (n=101). This included both current and former mentors. She used a random number generator to choose 20 mentors from this list, who were emailed and invited to participate in the interviews. Eight agreed to be interviewed. Three of these students are female and five are male, two were past presidents of the SPM, one was a supplemental instructor, and one was a robotics mentor and chair for several years; all eight of them served as a leader for the E^2 bridge camp at least once. Of these eight students, five had already graduated at the time of their interview, with three employed in various engineering industries and two attending graduate school. In order to remain anonymous for to the interviewer, the eight were assigned names "Peer Mentor One," "Peer Mentor Two," and so on. Pseudonyms have been used in this article for the reader's benefit: Hunter, Amber, Paul, Jessica, Kyle, David, Alexandra, and Carter. The SPM advisor contacted each mentor to set up times for each interview. The lead author was then given phone numbers without identification and a schedule for the interviews. Interviews consisted of a semi-structured set of questions with organic follow-up questions posed as deemed necessary to provide clarity. Each interview lasted approximately twenty-five minutes.

For this qualitative design, the lead author followed Tesch's [2] eight steps for inductively coding qualitative data:

1) review the full transcript
2) read one interview thoroughly
3) repeat for other interviews and make a list of all topics mentioned
4) develop a code for each topic
5) group topics into broader categories
6) arrange the final codes in alphabetical order
7) closely analyze all data in each category
8) recode some data if necessary

The recordings were transcribed by a third party, Elite Transcription, and then were reviewed by the authors, who read the eight transcripts multiple times, making notes of similar statements and highlighting potential emergent themes. All of the major topics were then listed in a spreadsheet and were ultimately assigned to one of three emergent themes: 1) development of leadership and communication skills, 2) improved sense of community, and 3) increase in motivation. The authors reviewed the themes and agreed with their assignment to the various thematic categories.

Creswell [3] suggests member checking as a means to ensure validity and reliability. Each participant was emailed a summary of the emergent themes identified in their interview transcript for verification. Later, the conclusions were emailed to the participants for corrections, additional thoughts, or suggestions. Finally, an external auditor reviewed the entire document, to provide an objective assessment of the complete project.

Results

Three main themes emerged from these interviews: development of leadership and communication skills, improved sense of community, and increase in motivation. Most of the benefits were listed and classified into one of the three main themes; however, a wide variety of additional responses were cited by individual interviewees. These responses that did not fit well into one of the three main themes were categorized as "other benefits."

Theme 1: Development of Leadership and Communication Skills

The eight participants mentioned twenty-eight benefits during the interviews. Seven of the eight peer mentors listed leadership or the development of leadership skills as a benefit. One of the interviewees, Hunter, described one way that leadership was honed within peer mentors:

> "I think the leadership trainings that we had were definitely very targeted toward what we were doing as peer mentors, so like being a leader to your peers, as opposed to being I guess a leader towards—well, the leadership skills, in general, but also just how to do that towards your peers, which is a bit different because you're in a situation where you just kind of—you wanna be friends with people, but you also have to have your boundaries…having the opportunity to be a leader of, I guess a group of six—I was a team leader of the camps, so I had a group of six people, and you really realize how

> different personalities are, how to handle those personalities getting together and doing something like a combined project, um, come together effectively to do that."

Hunter's experience illustrated that the program does not simply teach the peer mentors leadership theory; rather, the mentors learn strategies and then practice them as leaders assigned to project groups.

Amber mentioned that the leadership development often resulted in opportunities within other clubs and organizations across campus: "People use it as a springboard more often than not. Most of our mentors are a part of multiple clubs, both within engineering and outside… I'm also a part of clubs for chemical engineering, so I'm also in leadership in one of our science peer organizations on campus that's not associated with the College of Engineering."

Another benefit most often noted by the peer mentors was improved communication skills. Amber reflected: "Public speaking and putting presentations together and learning how to present myself in a meeting or interview, over the phone, I guess, just presenting in front of a group of people and to speak loudly and be well versed." Paul discussed how this benefit was more than a matter of being an interesting speaker, that it was an ability to communicate with audiences with a different background and knowledge base:

> "Now, in terms of communication, you're also asked to present regularly in front of people. The outreach programs are a really good example of going to high schools and trying to explain extremely complex concepts to students who don't necessarily have the same background as you. So, you really are able to kind of boil down these concepts into something that is easy to understand."

Another common benefit mentioned by the peer mentors is an important facet of leadership and communication—conflict resolution. This is a particularly meaningful benefit because many upper-level engineering design courses require working on teams and most engineers work on teams. Hunter described how this was utilized when the mentors were doing an outreach event:

> "You're told like this is how you should approach conflicts, um and like between either peer mentors, or if you're out at an outreach and you have a problem with either where you're supposed to be, or whoever is organizing the outreach, um, it was pretty good to be able to know how to handle those situations, and be in situations where you're in charge of, I guess how everything goes. Um, being like the outreach chair, like organizing people to go to a place and then figuring out how to get those people to do the right thing once they get to the place."

Paul connected the ability to resolve conflict with a future career as an engineer:

> "So, I would say, personally, I learned a lot about how to deal with people in terms of people on teams, how to mediate teams that weren't really doing well, even if I'm not necessarily in a position to do that. So, just because I'm not, you know, the boss, doesn't

mean that I can't later in life, so if I'm just a project engineer, if doesn't mean I can't, you know, try and fix some of the problems."

Theme 2: Improved Sense of Community

The eight mentors interviewed referenced the theme of community more than twenty times. From relationships with other peers to the physical space where the STEP Office was located, the participants found a sense of community. Jessica reflected:

> "That's really, um, it's supportive, um, I know I keep using that word a lot, but it's a good way to describe it. Um, you know, they [the staff] were always there. We were always there for each other. Um, you know, it was very inclusive. I didn't feel like anyone was ever, you know, left out of the group. Um, our door was always open to anybody in the College of Engineering. It didn't matter, you know, what they were struggling with, how well they were doing in college."

Hunter's experience was similar:

> "So, I went to the peer mentors' student office a lot and being able to use that space and interact with—hang out with all the other peer mentors, talk about engineering, get their opinions on like take this class, don't take this TA, go talk to this TA, this professor knows what she's doing. Really, everyone was pretty involved with their particular major, so you can get advice, you could get, find out what's happening easily, and that definitely helped me out with a few classes. Just being in that space where everyone's active in the college and willing to help each other."

The participants noted that the space was one in which students could complain about school and personal matters. Kyle recalls, "It was a good place to go talk to people sometimes and decompress, you know." Paul agreed, "The peer mentoring office was always a place that people could go to talk, you could study there, or you could just complain about something that's happening in your life and there'd be somebody around to talk about that. So, the office is pretty central to the whole culture of peer mentoring."

David mentioned that the professional staff was also central to the sense of community the peer mentors found in the physical office:

> "There was a spot on the second floor of the College of Engineering right next to where the [communication] lab used to be, and that was our, like our home base. And always there was somebody in there if you were in between classes you'd go and hang out, and [the staff] would be there and several mentors, maybe they were doing homework, maybe they were just hanging out. And we would have, we would have meetings and everybody would show up and listen, but even outside of that, we would, we would all hang out in that room and enjoy each other's company together. We were kind of tight-knit."

When the Society of Peer Mentors was formed, one goal was to provide a sense of community for new students. The sense of community among the mentors themselves was an

unexpected but welcome outcome of the program. And for some the community continued well beyond their time as a peer mentor, as Kyle shared about a recent reunion: "I actually just got back from a kind of a mini road trip, but I stopped and visited, visited a few peer mentors at internships at various places, so yeah, I'm definitely keeping in, keeping in touch and plan to as I go forward."

The sense of community was also apparent through students' mention of getting assistance with classwork or professors. This was an expected benefit because the program was initially launched as an effort to help the lower-year students who the participants mentor. Paul described the valuable study assistance: "I was studying with people who were in the peer mentoring program, people from years before were giving me advice on how to—how to study, how to learn dynamics."

Alexandra suggested that the mentors often ended up becoming study partners:

> "I've seen many people form study groups within the mechanical engineering side because they're in robotics. And then, the people who start off as freshman who get into robotics and stuff like that, they end up looking up to the upperclassmen for advice as in what type of skill set do I need for this class, what I need to focus on and they kind of help each other by challenging each other, as well."

Theme 3: Increase in Motivation

The mentors discussed the theme of motivation, specifically the motivation for becoming a peer mentor. Seven of the eight cited their experience with E^2, a pre-college camp staffed by the peer mentors, as a reason for becoming a peer mentor. Hunter recalled, "I really wanted to get involved with the college of engineering, and really the outreach programs, and also the [E^2] camp. I did the [E^2] camp coming in and those were two things that I wanted to get involved with the camp, but I was also really interested in everything else the peer mentors did." Kyle offered a similar reason, "I actually went through the camp, originally my first year, and then it was a load of fun and it was a good way to meet people."

Amber shared a more comprehensive definition of this motivation as a result of being a part of the pre-college camp:

> "I was motivated to become a peer mentor because I went through the [E^2] camp myself, and I saw the group that put on the camp and how much fun they were having, and how involved they were in, not only in the camp, but within the college of engineering, and I saw, I was told about the networking opportunities that came along with being in a group like this, getting to know people and the faculty and staff members."

Carter cited a similar motivation:

> "Uh, well, when I came to [this university] as a freshman I went through the program myself, and I loved what it did for me, and I loved the way that I met all of the people that I did when I went through it, and I wanted to be able to do that for somebody else."

While having participated in the pre-college camp was the most common motivator mentioned by the peer mentors, other motivating factors included the program's need for an SI instructor for electrical engineering, a major change, wanting to be a friend, looking to be an example, inspiring people, and getting outside of one's comfort zone.

Other Benefits

The mentors also mentioned other benefits, all important though less frequently cited and less richly described. Some interviewees indicated they discovered a sense of purpose through improving student retention (cited twice) and assisting to bridge the gap between high school and college. "Communicating care" and "guiding and supporting students" were also mentioned along with promoting leadership and promoting engineering. Additional benefits included becoming a more sympathetic person, becoming less reclusive, learning about study abroad, getting a job in a lab, growing in confidence, seeing how people approach problems differently, and networking.

Conclusions

This study adds to the body of literature on peer mentoring programs in higher education, specifically peer mentoring in STEM disciplines. Considering that the goals for peer mentoring are to help K-12 students and incoming freshmen, it is important to note how much this program has impacted the mentors themselves. The mentors talked about benefits to themselves more than any other theme; sense of community was the second most frequent theme that came up. This builds on the recent research done by Kiyama and Luca [8]. As they found, this study confirms that peer mentors may benefit as much as the protégés, in terms of feeling a part of a community and finding academic support. The interviews also reveal that the mentors, regardless of academic preparedness, found involvement with the mentoring program to be a motivator for their own academic success. It is obvious that involvement with the program provided them access to upper-year students who could help them with the subject matter and navigate the expectations of faculty members.

In the larger scope of student development theory, particularly Tinto's theory of persistence, this study provides an in-depth view of a program that bridges the social and academic communities of a campus. Many of the students spoke of finding both academic support and meeting many of their closest college friends through SPM. Tinto [14] stresses that failing to find either a social or academic community can result in attrition. In the case of the SPM, we find a program located in a major academic unit that achieves both.

Although a plethora of anecdotal evidence was collected over the decade of the engineering peer mentoring program at LSU, this qualitative study served to examine the benefits to these student leaders in a more rigorous and methodological way. Results of this research coupled with previous retention analyses served to inform college administration when making staffing changes. The peer mentor program stemmed from two NSF STEP grants and was in its last year of funding in 2018. In order to sustain the peer mentoring program, LSU's College of Engineering created a new, full-time, staff position that year. As with other successful

university student programs, having support staff is essential to continue to evolve and grow a program that benefits our student leaders.

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