Research in Engineering Education Symposium &
Australasian Association for Engineering Education Conference
5 – 8 December, 2021 - Perth, WA

A Self-Reflection on Lab Mentoring Practices for a Diverse Lab Group

Casey Haney, Claudio Freitas, Brenden Drinkard-McFarland, Moses Olayemi, Aziz Dridi, Alessandra Napoli, Fernando Perez, Dhinesh Radhakrishnan, Jennifer DeBoer
Purdue University
Corresponding Author Email: haney3@purdue.edu

ABSTRACT

CONTEXT

Mentoring in research environments can serve as a tool for building resilience and supporting those belonging to groups marginalized by race, gender, international status, and first-generation status (Alvarez et al., 2016; Patton, 2009). Mentorship experiences of students and professors who are approachable, respectful, and available correspond to higher student self-efficacy and motivation (Komarraju et al., 2010), and mentoring undergraduates in research has similarly shown increased academic and motivational outcomes (Ahn, 2014). This paper examines mentoring practices within an engineering education lab group composed of students from multiple countries, ethnicities, and educational backgrounds.

PURPOSE OR GOAL

Using the collective mentoring experiences of members of our lab group, this paper examines the following questions:
1. What are the key mentoring values of this specific lab group?
2. How do these values impact our lab group's mentoring practices and the difficulties surrounding our lab group's mentoring practices?

APPROACH

We employ collaborative autoethnography, a form of autoethnography that involves "engaging in the study of self, collectively; it is a process and product of an ensemble performance, not a solo act" (Chang et al., 2012). In the discussion section this paper will specifically compare these findings with existing mentoring approaches as defined in Pfund et al. (2016).

OUTCOMES

Our lab group mentoring practices are characterized by three core values: collaboration, growth through exploration, and care and belongingness. Each of these values is defined and described within this specific diverse lab group. Collaboration for the lab group extended far beyond apprenticeship and was better characterized as a web of collaborative mentoring relationships characterized by growing each person's expertise and contribution while also allowing for the development of formal and informal mentoring experiences. Growth through exploration encourages and supports students to actively engage in new research practices. Care and belongingness provide the foundation that the rest of the mentoring experiences are built on, allowing students to feel safe enough to grow and contribute. Each of these values also created specific difficulties and challenges including availability constraints, time management, communication issues, and concern regarding ability to contribute. When comparing these values to Pfund et al. (2016), these mentoring values best reflect interpersonal and psychosocial mentoring practices. These practices encouraged the building of other research related and professional skills associated with other types of mentoring practices (Pfund et al., 2016). However, core values of the lab group were most connected with interpersonal and psychosocial mentoring practices. These findings agree with literature that psychosocial mentoring practices that build care and belongingness are particularly beneficial to marginalized students (Alvarez et al., 2016).

KEYWORDS

Mentoring, Diversity

https://doi.org/10.52202/066488-0102

Introduction

Mentoring in a research environments can serve as a tool for building resilience and supporting those belonging to groups marginalized by race, gender, international status, and first generation status (Alvarez et al., 2016; Patton, 2009). Experiences between students and professors who are approachable, respectful, and available lead to higher self-efficacy and motivation (Komarraju et al., 2010), and mentoring undergraduates in research has similarly shown increased academic and motivational outcomes (Ahn, 2014). While the benefits of mentoring are clear, many universities do not have clear avenues for fostering these mentoring relationships for marginalized populations (Alvarez et al., 2016). Thus, this paper focuses on understanding the mentoring relationships developed in a single lab group with a team of students that spans several marginalized groups. Several frameworks have been created to analyse the roles, processes, and stages of mentoring (Dominguez & Hager, 2013). The roles of mentors have been described as allies, ambassadors, and master-teachers for their mentees (Lechuga, 2011). Several frameworks have set out to describe successful mentorship (Cho et al., 2011). These frameworks often describe mentees as simply in a receiving role that can eventually grow into the role of a peer while some frameworks emphasize the importance of peer-to-peer mentoring and collaboration such as communities of practice and through action learning (Dominguez & Hager, 2013). While mentoring is often described as one on one relationships, research environments often have informal mentoring or systems of mentoring implemented within a lab group structure (Ahn, 2014). This paper will contribute to the conversation around mentoring practices by describing the mentorship in practice for a diverse lab group where mentoring relationships can face additional barriers due to cultural and communication differences. and connect these findings with prior literature.

Method

This study will use collaborative autoethnography to examine the processes associated with mentoring for a diverse lab group. Autoethnography is a study of self, a study of the researcher's own group by examining the structures and experience taken for granted within the group (Eriksson, 2010). The focus of an autoethnography is applying methodological tools and research literature to analyse experience in a way that describes an unfamiliar environment for the reader (Ellis et al., 2010). Specifically, this paper will employ collaborative autoethnography, a form of autoethnography that involves "engaging in the study of self, collectively; it is a process and product of an ensemble performance, not a solo act." (Chang et al., 2012). This paper will compile and analyse the experiences of the undergraduates and graduates in a lab group focusing on the experiences each have in regard to mentoring. Experiences were gathered anonymously through reflection and then compiled into themes by various authors and confirmed by the entire lab group. As much as possible, exact wording from reflections were used both in framing each theme and in the examples given for each theme. Examples are meant to reflect the average experience within the lab group and are thus not attributed. This close collaboration helped shape the interpretation of the mentorship experience and individual reflections.

Context

This lab group is situated in a large midwestern research university in the Engineering Education department. Although the lab is mostly composed of international students, there is a wide spectrum of diversity in the lab group across ethnicities, genders, and first-generation status. At the time of the initial theme generation: There were 6 graduates or post-doctoral students and 5 undergraduates. There were 6 males and 5 females. Race/ethnicity lab demographics were 4 Caucasian, 2 African American, and 5 international students (Latin American, South Asian, and African). These numbers vary with semester changes, graduations, visiting scholars, and new hiring.

https://doi.org/10.52202/066488-0102

Mentorship in the lab group is generally done through formal and informal pathways. Graduates and undergraduates meet with the head professor regularly. Undergraduates meet with the graduate students for their respective projects. Informal groups have formed on various topics and informal mentoring relationships have formed as needed. Lab practices are reflected upon and re-evaluated each semester by all in the lab group and throughout the semester as smaller adjustments are needed.

Results

This lab group came to a consensus description of good mentoring within the lab group as a process involving availability, transparency, and openness in a comfortable and safe environment conducted both formally and informally built through conscientious listening, a friendly relationship, help breaking down problems, and mutual sharing of experiences and knowledge. This definition reflects several of the practices of the lab summarized by three themes developed from the shared experiences of members of the lab group: collaboration, growth through exploration, and care and belongingness.

Collaboration: “The Mentoring Web”

Our analysis shows that the collaboration model in the lab enables mentor-mentee relationships to happen formally and informally between multiple members of the lab. This collaboration model is described as a "mentoring web" by one member of the lab which is also emphasized by other members in terms of how this collaboration occurs across several projects. We also identified a strong sense of collaboration beyond research projects, which can be identified in moments outside of the lab hour or even during outside guest visits. While visiting other lab groups and hosting students from other labs, collaboration was one of the key differences noticed in how our group approaches mentoring. As one member of the lab said:

> *"A person does not just come into our lab. They are welcomed and connected. Coming into the group originally as an undergraduate student, I watched the connections grow. It was not just the graduate student I was assigned to who taught me the basics of research. It was the graduate students who gave feedback as I presented and were willing to teach me various components of research. It was our professor who was willing to give feedback not only on our immediate work but on our life plans and willing to place us in the areas that intersected with our goals."*

Further, our data analysis shows that mentoring in this lab goes beyond one time but instead happens with the goal of creating long-term, collaborative, mutually respectful relationships. We have an open and collaborative environment that allows us to support each other in all sorts and different types of projects/activities/tasks in our lab helping us to share our honest opinion and feedback. On the other hand, we also identified that this extensive collaboration is also time-consuming. As one member said, "the mentoring and collaboration style in our lab requires probably more time than a more “traditional” style, and time is a resource we have little of". Therefore, we identified that members of the lab need an appropriate environment that allows time flexibility in order to sustain a collaborative environment that can take many shapes.

This collaborative environment also calls attention to how members build and share interests in specific topics across different projects. This aspect of sharing interest and knowledge across different projects is highlighted by one of the members. Collaborative groups and

https://doi.org/10.52202/066488-0102

mentoring forms around shared interests and goals, but each lab member is also contributing to each of the projects in smaller or larger ways.

> *"Every person in our lab can talk about almost all of the projects. Even though we have not been in the minutia of each project, we are there giving feedback from the beginning to the end of each project. We are there offering our skills, our critiques, and our support. Once during a methods class, I could come up with an example of each type of research method from our lab's workday after day. The professor finally asked, "How many projects do you have?" Yet, this is so far from how projects are assigned in our lab group. Yes, we have "our" projects, but we are expected to contribute to and learn from all the projects in the lab. Undergraduates are no less than graduate students in the expectation that they are listening, learning, and contributing."*

The goal of collaboration draws heavily on communities of practice mentoring style as described by Dominguez & Hagar (2013). This form of mentoring focuses on the benefits that each individual is bringing to the group. It allows for the flexibility of individuals moving in and out of the mentor and mentee roles as each individual offers their expertise (Dominguez & Hager, 2013). This is best demonstrated in the way we navigate between the roles of mentor and mentee. Serving as a mentor or mentee is usually precipitated by need and demonstrated competency and very rarely by seniority. Traditionally, graduate students further along in their studies mentor newer graduate students and undergraduates. However, our lab group created much more flexibility where learning had no connection with seniority. Older graduate students, newer graduate students, and undergraduates are equally likely and willing to learn new skills or teach new skills to the rest of the group.

Overall, collaboration also grows interpersonal relationships while building research skills. These are two key components of Pfund, et. al.'s (2016) effective mentoring attributes. The research component involves building new skills and is what is traditionally thought of as mentoring. The interpersonal component involves building relationships that can help support communication (Pfund et al., 2016).

Growth through Exploration

As new members come in with very little research experience starting off, they are guided in exploring what it means to go through a research process from various mentors. Our analysis revealed that members of the lab often participated in multiple research projects during their earlier stages in the lab, but at the same time, they often reported a collaborative environment where each member relied on each other to succeed in their professional growth. In some cases, doctoral students served as mentors to help undergraduate students to conduct research tasks, as one noted:

> *"My first systematized literature review was a very novel experience for me. I needed plenty of directions about how to frame a research question, how to choose a topic of interest, and how to report my findings. I really appreciated being mentored throughout the process by two doctoral students in our lab."*

https://doi.org/10.52202/066488-0102

While our analysis revealed an intense collaboration across multiple members in the lab that supported growth, we also identified that a couple aspects should be taken into account as part of the mentoring practices in the lab. First, we identified that members have different research interests, and it needs to be considered before approaching lab members considering their research background and expertise on a specific research method or theory. Second, students with a very specific research might be biased towards a particular research method. These two factors are important to be considered because as students grow through exploration, they need to recognize the different lab expertises and research interests in order to fully take advantage of the different projects. Our lab group often goes beyond simply guiding but actively encouraging exploration, questions, and curiosity considering that students have a good understanding of their research environment in order to receive informed mentorship and encouragement. Part of this encouragement comes from creating a safe environment where such exploration can happen. As one member noted:

"Research is a complex endeavour and learning that while living in a new culture and environment away from home was challenging. Most of my memory, I have of being mentored has been to comfortably and confidently pursue education and feel safe."

Growth through exploration is related to mentoring through action learning. In our lab, a number of factors contribute to this process, such as research diversity, trustworthiness to share ideas, and freedom of choices. Growth through exploration focuses on the mentor as a guide or facilitator as the mentee actively engages in the work (Dominguez & Hager, 2013). Within the Pfund et. al. (2016) framework, this corresponds to both research and psychosocial components of mentoring where mentees receive support that helps build their identity as a researcher and self-efficacy. Growth through exploration is intimately connected with the next theme of care and belongingness as mentees must feel safe enough to explore and fail as they engage in research.

Care and Belongingness

The words "open", "willing", "understanding," and "intentional" describe the mentoring that happens in this group. Whether it be from the professor to graduate students or graduate students to undergraduates, these four descriptors perfectly capture the natural mentor-mentee relationships that have formed.

"As a newbie I felt welcome, and everyone was willing to pitch in and show me the ropes. I would describe that as great mentoring since I never felt like I did not belong or did not know what to do."

This care and belongingness come out through the inclusion of everyone in the lab group in activities, feedback, and opportunities for growth. Meetings are not just for complete work, but instead are filled with the struggles each student is working through in research and in life. Through this outlet, there is time for support and new mentoring relationships to spring from those who have previously had the same struggles.

"One experience in particular stood out for me. I was new as an undergraduate and going to my first lab meeting. I was listening and trying

https://doi.org/10.52202/066488-0102

to understand all the new terms floating in the air. Our professor turned to me after one of the presentations was done and asked for me to give feedback. What feedback did I have to give? In my mind, I was new to all of this and could not offer much. Yet, everyone contributes, everyone's thoughts are useful, and everyone belongs. Later, I was still afraid of looking right in these meetings and only presented my best work. One week when I was scheduled to present, everything was far from done. The feedback I got wasn't criticism, but instead was assistance helping me move the project forward and giving me a new perspective."

While many mentoring frameworks do not necessarily name care and belongingness as key concepts (Dominguez & Hager, 2013), they are the groundwork that many of these mentoring relationships are built upon. Care and belongingness are emphasized as key components for mentoring relationships to benefit marginalized students (Alvarez et al., 2016). Still, we call attention to a couple aspects of care of belongingness that should be taken into account in similar settings. Our data revealed that members should clearly define their boundaries in terms of criticisms when giving feedback. In addition, cultural perceptions should be highlighted and considered when giving and receiving feedback. By having a clear perception of level of criticism and cultural perceptions, we can clearly connect care and belonging to the words often described in our data, such as "open", "willing", "understanding," and "intentional".

Challenges

Examining the perception of mentoring within the lab group by lab members has identified strong themes of collaboration, growth, and belongingness. These themes prove through positive interactions fostered by the mentor-mentee relationships that mentoring benefits the lab group as it navigates through research. However, mentoring as described by the lab group has its challenges as well, presented in various forms such as availability constraints and time management, communication issues and concern regarding ability to contribute. The following delves into how each of these concepts have affected the lab group.

While growth through exploration and care and belongingness are key lab group values, they are not always easy in practice as was noted by the lab group.

"In the mentor-mentee relationship, mentees feel ashamed of letting their mentors down especially when they are learning a complex skill for the first time. The many times they fail before they get it is fine for them, but the moment they get whatever the mentor was trying to model, they want the mentor to walk away, look away, so they can figure the rest out themselves...I think it's because they don't want to let their mentor down...now that they have gotten it the first time."

Mentees can feel like they need to prove themselves leading them to be afraid of failing or afraid of asking questions. While the lab culture focuses on working against these issues, shame or fear or failure can still prevent students from fully feeling supported in these areas.

A key issue of mentoring is creating time for the mentoring to occur and managing time within mentoring projects. In our lab group, various projects are being worked on simultaneously by members. Thus, time management created particular challenges for mentoring and maintaining mentor-mentee relationships within the group.

https://doi.org/10.52202/066488-0102

"Availability is certainly one of the issues that I've run into where mentoring in our lab is concerned."

Members noted that time is a resource not held in abundance, and that on rare occasions deadlines would not be met by individuals in a mentor-mentee relationship. This leads to several issues including issues meeting deadlines and generally having less time to complete work.

"Time is a big one - the mentoring and collaboration style in our lab requires probably more time than a more "traditional" style, and time is a resource we have little of."

Time and support were also given as key to the development of effective mentoring in Cho, et. al.'s (2011) findings. Strong and effective communication may help address this issue. Communication itself was established to be a challenge for mentoring aspects of the lab group. However, cultural barriers in the lab group tend to create opportunities for miscommunications. Specifically, intent and delivery can be compromised due to the perception of feedback between the mentor and mentee figure.

"I think we have had to negotiate a style of communication between mentor and mentee. I suppose there's a part of that that is cultural. Sometimes, as a mentor, I suggest some things to my mentee when they should be more strongly communicated as imperative. At such times, I find the mentee coming back to say they didn't know what I was suggesting was a paramount factor."

Cultural responsiveness is one of the key components of effective mentoring and communication that actively acknowledges biases and diversity of viewpoints is key within mentoring (Pfund et al., 2016). Our lab group often meets this challenge through seeking a deeper understanding of each other and celebration of one another's cultural differences as a key part of the growth and belongings in order to foster connection with each other. This focus best combats the imposter syndrome and negative preconception installed in oneself as a new member and mentee.

"A challenge that I initially faced while being mentored was getting over a fear of asking a lot of questions. It took some time to be able to ask for multiple clarifications on something because I felt like it would make me look bad/not good at this if I did ask that much."

While these challenges do continue to impact the lab group, lab group practices are continuously evaluated to better implement the vision of our group and help to improve the mentoring environment. Recent improvements and changes have included evaluating onboarding into lab procedures to make the transition into being a lab member easier for new graduate students and undergraduates.

https://doi.org/10.52202/066488-0102

Conclusion

Overall, this lab group employs a mix of communities of practice and active learning within its formal and informal mentoring behaviours. This practice leads to three areas of emphasis: collaboration, growth through exploration, and care and belongingness. Collaboration emphasizes each person's expertise and contribution while also allowing for the development of formal and informal mentoring experiences. Growth through exploration encourages and supports students to actively engage in new research practices. Care and belongingness provide the foundation that the rest of the mentoring experiences are built on as students feel safe enough to grow and contribute. Our findings also describe how mentoring practices can happen in research environments with a diverse group of students and how this mentoring process can help students to thrive and grow.

Citations

Ahn, B. (2014). *Creation of an instrument to measure graduate student and postdoctoral mentoring abilities in engineering and science undergraduate research settings* [Ph.D., Purdue University]. http://search.proquest.com/docview/1647472812/abstract/B17A0D3359794F09PQ/1

Alvarez, W., De Walt, P. S., Genao-Homs, M., & Yun, J. (2016). Multidisciplinary Graduate Student Alliance (MGSA): Crafting a Diverse Peer Mentoring Network Within and Beyond a Predominantly White Institution (PWI). In B. G. G. Johannessen (Ed.), *Global Co-Mentoring Networks in Higher Education: Politics, Policies, and Practices* (pp. 127–154). Springer International Publishing. https://doi.org/10.1007/978-3-319-27508-6_8

Chang, H., Ngunjiri, F., & Hernandez, K.-A. C. (2012). *Collaborative Autoethnography*. Taylor & Francis Group. http://ebookcentral.proquest.com/lib/purdue/detail.action?docID=1110067

Cho, C. S., Ramanan, R. A., & Feldman, M. D. (2011). Defining the Ideal Qualities of Mentorship: A Qualitative Analysis of the Characteristics of Outstanding Mentors. *The American Journal of Medicine*, *124*(5), 453–458. https://doi.org/10.1016/j.amjmed.2010.12.007

Dominguez, N., & Hager, M. (2013). Mentoring frameworks: Synthesis and critique. *International Journal of Mentoring and Coaching in Education*, *2*(3), 171–188. https://doi.org/10.1108/IJMCE-03-2013-0014

Ellis, C., Adams, T. E., & Bochner, A. P. (2010). Autoethnography: An Overview. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *12*(1), Article 1. https://doi.org/10.17169/fqs-12.1.1589

Eriksson, T. (2010). Being native – distance, closeness and doing auto/ self-ethnography. *ArtMonitor*, *2010*(8), 10.

Komarraju, M., Musulkin, S., & Bhattacharya, G. (2010). Role of Student–Faculty Interactions in Developing College Students' Academic Self-Concept, Motivation, and Achievement. *Journal of College Student Development*, *51*(3), 332–342. https://doi.org/10.1353/csd.0.0137

Lechuga, V. M. (2011). Faculty-graduate student mentoring relationships: Mentors' perceived roles and responsibilities. *Higher Education*, *62*(6), 757–771. https://doi.org/10.1007/s10734-011-9416-0

Patton, L. D. (2009). My Sister's Keeper: A Qualitative Examination of Mentoring Experiences Among African American Women in Graduate and Professional Schools. *The Journal of Higher Education*, *80*(5), 510–537. https://doi.org/10.1353/jhe.0.0062

Pfund, C., Byars-Winston, A., Branchaw, J., Hurtado, S., & Eagan, K. (2016). Defining Attributes and Metrics of Effective Research Mentoring Relationships. *AIDS and Behavior*, *20*(2), 238–248. https://doi.org/10.1007/s10461-016-1384-z

Copyright statement

https://doi.org/10.52202/066488-0102