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Set and Spike: Mentoring a Student-Athlete in STEM for Undergraduate Engineering Education Research

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PURM
Perspectives on Undergraduate Research & Mentoring

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This dialogue paper is written as a critical collaborative autoethnography (CAE) from the perspective of Dr. Leroy Long III, a Black male assistant professor, and McKenna Gooch, a White female former student-athlete. Dr. Long holds a PhD and conducts research in STEM – science, technology, engineering and math – education while McKenna is completing a master's degree and working full time in engineering. We share our personal narratives of how our faculty-student mentoring relationship led to the formation of our research group named Team EASE – Engineering, Arts, & Sports Engagement. Participation on Team EASE has provided us with invaluable experience creating infographics and research posters, delivering research presentations and invited talks, along with securing research grants and personal accolades.

In this article, we aim to provide unique insights about mentoring a student-athlete in STEM for undergraduate engineering education research. We have chosen to use the term "underrepresented people" to represent the composition of some gender and racial-ethnic groups in engineering, including White women and Black/African American men (Long & Mejia, 2016; National Science Foundation [NSF], 2016; Strayhorn et al., 2013). We believe the focus of this paper will help address the current gap in literature surrounding the mentoring experiences of student-athletes in research settings (Sterrett et al., 2018). We aim to draw attention to the unique and understudied faculty-student mentoring experiences involving underrepresented people and student-athletes in STEM research settings (Bimper, 2017; Mondisa, 2014; Sterrett et al., 2018).

Dr. Long: A couple of weeks before the start of Fall Semester 2019, I received a text from McKenna telling me she "got into grad school!" Less than a month earlier, she texted me saying she would be "applying for … [her] Masters [in Engineering]" and needed "a letter of recommendation." As her former undergraduate research mentor, I was excited to hear that she planned to continue her education. I thought it was good that she would still be familiar with the everyday demands and expectations of higher education. She previously displayed great time management skills while working with me on engineering education research, taking rigorous undergraduate engineering courses, playing Division II volleyball, and having a social life. I admit that I selfishly imagined she might get bored after working full time in industry and return to work on more research with me.

While writing a letter of recommendation for McKenna, I thought back to Spring Semester of 2016 when I first met her as a student in my introductory engineering and computer-aided design (CAD) course. I still recall how I initially noticed her sitting off to herself in class. I assumed McKenna was a student-athlete on the women's basketball or volleyball team due to the athletic gear she wore and

her tall, lean build. While working to finish as one of the top students in my class, I was impressed with her dedicated work ethic and willingness to ask for help.

When looking to hire undergraduate research assistants, I compiled a list of my former top students. I also considered students who had worked with me as a teaching assistant (TA) along with students I had advised in Embry-Riddle Aeronautical University (ERAU)'s chapter of the National Society of Black Engineers (NSBE). A year and a half after having McKenna as a student in my class, in the Fall of 2017, I emailed her about my open research position. I was pleased to receive a reply from her saying she was "very interested." We agreed to meet about the position, and I hired McKenna about a month into Fall Semester of 2017. She became my fourth undergraduate research assistant and first current student-athlete.

McKenna: After graduating from ERAU, I moved to the West Coast to begin my career as a systems engineer with Lockheed Martin. I decided to pursue my master's due to my future aspiration of becoming a college professor like Dr. Long. The research I performed with him during my undergraduate years sparked a passion to provide an inclusive environment for underrepresented people in STEM, which is now my long-term goal. Since I wanted to continue my education while I was still in "student mode," I immediately began applying to grad schools. I was not concerned about the commitment of being a full-time engineer and full-time master's student, because I had spent the last four years as a student-athlete. Time management was crucial to my success when managing rigorous engineering courses, volleyball practices and games, engineering education research, and an occasional part-time job.

Dr. Long was the first person that came to mind for a letter of recommendation. Throughout my time as an undergraduate, we worked closely together while performing research on underrepresented people in STEM. Although our primary focus was research, Dr. Long supported me through my courses, internship application, and professional development. Therefore, it was a simple choice to ask him for a letter of support. Dr. Long's enthusiastic response to my request for a letter of recommendation showed his continued support of my education.

I first met Dr. Long when he was my professor for an introductory engineering course. His teaching methods matched my learning style very well, which helped me earn an A in his class. Continuing my education at ERAU and working on more research with Dr. Long was my first option; however, the University of Arizona (U of A) provided an excellent, affordable online program supported by Lockheed Martin. When I received my acceptance letter from the U of A, I was ecstatic to continue my education!

When I received an email from Dr. Long regarding a research opportunity, I was in the first semester of my sophomore year and the beginning of my volleyball season. I was searching for a flexible work opportunity when the email arrived in my inbox. Perfect timing! The flexible research opportunity was not only a paid position but more importantly a chance to learn. Therefore, I was quick to respond with my interest and planned an interview with Dr. Long. During our conversation, we immediately connected because of our shared research interest and I was offered the job! I was elated to grow my research skills and deepen my knowledge of STEM opportunities for underrepresented people!

Background Literature

For the purposes of this dialogue paper, we define mentoring as the "process in which an experienced individual (a mentor) acts as a role model and guide for a less experienced person (a protégé) specifically advising he or she in academic, personal, and/or professional aspects of their lives" (Mondisa, 2014). We recognize that mentors can positively influence their protégé's self-esteem, academic achievement, leadership skills, and career motivation (Mondisa, 2014). Below, we

review literature on mentoring of undergraduate students for research. We cover existing research on mentoring student-athletes and underrepresented people in STEM.

Mentoring Undergraduate Students for Research

Limited work has been performed on mentoring relationships between faculty and undergraduate students for research. Undergraduates who gain early research experience, in the social sciences and humanities, develop the ability to think analytically and logically, collaborate on ideas, and be self-sufficient (Ishiyama, 2002). As a result of student-faculty research partnerships, undergraduate science scholars increase their technical expertise and communication skills (Behar-Horenstein et al., 2010). Mentoring relationships increase students' retention rates and are most significant among African Americans as well as sophomores (Nagda, 1998). Underrepresented faculty members also have higher retention and success rates when they provide mentorship to underrepresented students (Fries-Britt & Kelly, 2005).

Mentors help student researchers deepen their disciplinary understanding and establish their research identity (Linn, 2015). Students also benefit from hands-on experience and career preparation (Seymour, 2004). Furthermore, by challenging Latino STEM students intellectually, faculty help them improve their grade-point averages (GPAs). STEM and underrepresented students receive similar benefits from other faculty-student mentoring relationships (Kardash, 2000).

Mentoring Student-Athletes and Underrepresented Students in STEM

Mentoring of undergraduate researchers has been explored for some subgroups of students, but far less attention has been given to mentoring of student-athletes in research settings (Sterrett et al., 2018). Even less focus has been placed on the unique experiences of some student-athletes in research settings (i.e., women, Blacks, Latinos, Native Americans, etc.) (Bimper, 2017; Sterrett et al., 2018). In some sports, women and student-athletes of some racial-ethnic groups are represented at or near their percentage of the US population (NCAA, 2018). Yet, the aforementioned groups remain underrepresented among faculty and coaches who can mentor student-athletes (Myers, 2016).

Limited work exists on mentoring of underrepresented STEM students (Mondisa, 2014; 2016). Much less attention has been given to mentoring of underrepresented STEM students in research settings (Thiry & Laursen, 2011). Within many STEM fields, women and some racial-ethnic groups (i.e., Blacks, Latinos, Native Americans, etc.) have historically been underrepresented at the faculty and student ranks (Myers, 2016; NSF, 2016). Underrepresented STEM students face restrictive admissions policies and curricula, lower academic expectations, and deficit-based thinking from faculty and staff (Long & Mejia, 2016). Underrepresented STEM students also report feeling alone and invisible while experiencing a lack of same race peers and faculty members (Strayhorn et al., 2013). They also face racism, sexism, and other forms of discrimination (McGee & Martin, 2011; Smith & Gayles, 2018). As a result, underrepresented STEM students have had reduced opportunities for peer or faculty mentorship from individuals with similar genders or races.

Purpose

Using critical CAE, we aim to provide unique insights about the mentoring relationship between a student-athlete and an assistant professor in engineering for undergraduate engineering education research. We share our personal narratives of how this mentoring relationship led to the formation of Team EASE, which has impacted the development of a faculty member and numerous undergraduate student researchers. Participation on Team EASE has provided us with invaluable experience creating infographics and research posters, delivering research presentations and invited talks, along with securing research grants and personal accolades.

Relevant Theory

Given our faculty-student mentoring relationship for research, we believe cognitive apprenticeship theory (Collins, Brown, & Newman, 1987) is the most appropriate framework for this dialogue paper

Cognitive Apprenticeship Theory

Cognitive apprenticeship is a social constructivist framework where learning is situated in authentic activities, and individuals learn cognitive and metacognitive skills through guidance by a more experienced individual (Collins et al., 1987). Within this framework, learning initially occurs on the periphery of the activity and as the individual develops skills, they are able to progressively engage more fully in the activity (Lave & Wenger, 1991). In order to support the individual through a cognitive apprenticeship, methods associated with modeling, explanation, coaching, scaffolding, reflection, articulation, and exploration have been used by the more experienced individual (Table 1).

Table 1. *Methods Identified to Support Cognitive Apprenticeship**

Method	Definition
Modeling	Explaining why activities take place as they do
Explanation	Demonstration of the process of thinking
Coaching	Monitoring activities and assisting where necessary
Scaffolding	Providing progressively less support based on student need
Reflection	Self-assessment and analysis of performance
Articulation	Verbal explanation of reflection
Exploration	Form hypotheses and test them to find new viewpoints

* Collins et al. (1987); Enkenberg (2001); Dennen & Burner (2008)

Cognitive apprenticeship has been widely used in educational contexts, when examining and designing curriculum that situates students within a realistic scenario, especially within the use of problem/project-based learning and inquiry learning techniques (Savery & Duffy, 1995). Within engineering education, applications of cognitive apprenticeship are commonly associated with inquiry in senior design courses but have also seen a broad range of implementations as an instructional methodology in core courses. Less work explores how cognitive apprenticeship can support faculty as they mentor student-athletes in STEM for undergraduate research.

Methods

Since we aim to provide unique insights about mentoring a student-athlete in engineering for undergraduate engineering education research, we selected a methodological approach in CAE that is collaborative, autobiographical, and ethnographic (Chang et al., 2016). We sought to help readers "relive the events emotionally with the writer[s]" as we reflected upon lessons learned from our mentoring relationship (Richardson, 1994, p. 521). We believe people develop their own knowledge and awareness of the world through lived experience, so this dialogue paper was also written from a critical constructivist epistemological viewpoint. We think critical constructivism offers a more in-depth method for our collective stories regardless of the perceived theoretical tensions. By using critical constructivism and CAE to research in "theoretical borderlands" (Abes, 2009), we were able

to use dialogue to understand our realities (Denzin & Lincoln, 2002) and examine power structures (involving athletics, gender, race, etc.).

Methodological Approach

Through CAE, more than one researcher serves as the instrument and data source. CAE builds upon the definition that an "autoethnography begins with the self, the personal biography. Using personal narratives, the researcher goes on to say something about the larger cultural setting and scholarly discourse, taking a sociological rather than a psychological perspective" (Glense, 1999, p. 181). When using CAE, multiple researchers go beyond "self" while examining how their personal narratives map onto sociocultural contexts (Chang et al, 2016). CAE uses dialogue to analyze the ways in which sociocultural contexts shape both collective and individual meaning-making (Chang et al., 2016). For example, "CAE offers us a scholarly space to hold up mirrors to each other in communal self-interrogation and to explore our subjectivity in the company of one another" (Chang et al., 2016, p. 26). Benefits of using CAE include: collective exploration of researcher subjectivity, deeper learning about self and others, community building, efficiency and enrichment in the research process, and power-sharing among research participants (Chang et al., 2016).

We not only wanted to use CAE, but we also wanted to situate our narratives within the sexist, racist, and athletically biased views that have historically plagued academia (Harper, 2012; Patton, 2016). We were interested in highlighting the cultural and social significance of a Black male assistant professor providing research mentorship to a White female former student-athlete. We were especially intrigued by the development of the above mentoring relationship against the racialized and gendered backdrop of U.S. higher education (Patton, 2016). Therefore, critical autoethnography allowed us to use "data to analyze how structures of power inherent in culture inform some aspect of [our stories]" (Merriam & Tisdell, 2016, p. 60).

Approach to Data Collection and Analysis

When using CAE, we followed a four-step process for data collection and analysis. The four steps were preliminary data collection, subsequent data collection, data analysis and interpretation, and then report writing (Chang et al., 2016). First, we began preliminary data collection through individual reflection and writing about our mentoring relationship. We shared our writing with one another and probed each other for more descriptive details or facts. Second, we completed more individual reflection and wrote about our mentoring relationship. We again shared our writing with one another and focused on initial collective meaning-making. Third, we started data analysis by individually reviewing and coding our reflections. We then did collective meaning-making and a group search for themes. Fourth and finally, we transitioned back into individual outlining and meaning-making in order to complete collective writing of our individual and shared perspectives. Overall, using the stated strategy, we followed a cyclical rather than linear approach to data collection, data analysis, interpretation, and writing. Our cyclical approach began just before Fall Semester 2019. We regularly reflected on our mentoring relationship and later wrote personal reflections. We also communicated periodically via text messages, email, phone calls, or video calls.

Trustworthiness

Peer debriefing was our primary method for maintaining trustworthiness while using a qualitative approach such as CAE. This method allowed us to reduce bias, vagueness, and errors in our shared stories. Our choice of using CAE was strengthened by knowing it has a built-in mechanism that allows for communal dialogue regarding self and others (Chang et al., 2016). Before submitting this paper, we also contacted other former and current undergraduates on Team EASE to see if our statements accurately reflected their perceptions of the team. We think the above strategies helped maintain trustworthiness while using CAE for this dialogue paper.

Positionality

Dr. Long: Several attributes of my identity inform my positionality as a researcher on this dialogue paper that is written in the form of a CAE. First, I identify as a straight, Black, cisgender, married man. Second, I am an assistant professor who became interested in engineering after attending a STEM summer-enrichment program in middle school. Third, prior to college, I played organized sports such as baseball, basketball, track, and bowling. I am the son of parents who played varsity sports in high school, such as volleyball and baseball. I enjoy watching/playing sports as an avid sports fan. Other attributes of my identity include my upbringing in a racially and ethnically segregated mid-sized city as well as my previous attendance at two public predominantly White institutions (PWIs) in the Midwest. As a follower of Christ, I believe in God and my spirituality guides my work involving student-athletes and underrepresented groups in STEM.

McKenna: I am a White female born into a two-parent, military household. After graduating with an undergraduate engineering degree, I accepted a job as a systems engineer for a global aerospace company. I am continuing my education by pursuing a master's degree in systems engineering. In addition, I danced intensively from a young age prior to transitioning to sports. I began playing volleyball and basketball in middle school and continued through high school. I competed in Division II volleyball on a scholarship during my undergraduate career. I was the starting middle and one of the top scorers for three years. I received All-Tournament Team and Top Five in multiple college volleyball records during my senior year. Other attributes of my positionality include being a woman in a male-dominated career field. Based on my positionality, I focused my research on STEM education experiences for student-athletes and underrepresented groups in STEM.

Findings

Serving the Ball: Mentorship and Research Begins

Dr. Long*:* I was excited to hire my first two undergraduate research assistants (a White female business major and a Black male engineering major) during the Fall Semester of 2016. I hired a third student (a Black female engineering major and former student-athlete) during the Spring Semester of 2017. It was my second year as a tenure-track research faculty member in engineering at ERAU. In the Fall of 2017, McKenna became my fourth undergraduate research assistant and first current student-athlete. I already had some experience mentoring and socializing undergraduates for engineering education research. However, I was unaware of the unique challenges and opportunities that exist when mentoring current student-athletes for undergraduate engineering education research. I realized McKenna was not only working with me on engineering education research, but she was also taking rigorous undergraduate engineering courses, playing Division II volleyball and striving to have a social life. I quickly became sensitive to her overall schedule.

By the time I hired McKenna, my routine for filling an open undergraduate research position consisted of emailing former students, teaching assistants, and NSBE students, as well as posting a job announcement with ERAU. I had interested students email me a copy of their resume and provide available times for an initial meeting. If I decided to hire the interested student, then I would compare our schedules to establish recurring one-on-one meetings in my office and to determine when the student was available to work on research. Next, I would share verbal and written details about my overall background and research interests and then have the student apprentice share the same details with me.

During my interview with McKenna, I recall noticing an immediate research synergy due to our shared interests in sports, organizational skills, optimistic outlooks, ability to work with diverse people, and passion for affirming underrepresented people in STEM like us. I truly thought she was a godsend and I was encouraged by the scripture, "Blessed are those who hunger and thirst for

righteousness, for they shall be satisfied" (Matthew 5:6 English Standard Version). I hired her on the spot! My decision "paid off!"

McKenna: Prior to my research position with Dr. Long, my research experience was limited to science fairs and reports, and my interaction with professors was restricted to class sessions and office hours. Therefore, my research with Dr. Long was the first time I worked with a professor outside of class. Although I lacked research experience, he was open to teaching me and helping me grow. When I was hired, I was occupied with engineering courses and a new volleyball season. Between a full-course load and excessive volleyball commitments, my time was limited. However, Dr. Long was open to coordinating our one-on-one meetings around my courses along with my volleyball games, practices, and travel. His sensitivity to my full schedule helped me thrive in volleyball, engineering, and research.

From our initial conversation, it was comfortable and easy to work with Dr. Long. This experience immediately helped me connect with him and receive mentoring. My interactions with other male professors were uncomfortable, stiff, and sometimes disrespectful. So, prior to my research position with Dr. Long, my mentoring relationships were limited to only women. As a Black man, Dr. Long could connect with me and understand the challenges I've experienced as an underrepresented person in STEM. After sharing his background and research interests, I shared my passion for similar topics including sports, underrepresented people in STEM, and engineering education. We shared a love for improving opportunities available to underrepresented groups and growing relationships with diverse people. Our optimistic mindsets were a strength when exploring topics with limited research and a negative history.

When I began working with Dr. Long, my first assignment was to explore my research interests. I performed a literature review on topics such as a) student intersectionality in engineering and b) student-athletes in engineering. Then, I created infographics to show youth that they could pursue careers in engineering and professional sports. We interviewed underrepresented student-athletes in STEM to learn about factors that caused them to pursue sports and STEM. We discovered factors such as parents' professions, childhood neighborhoods, career aspirations, role models, and tuition burdens. One research participant said, "People undermine [underrepresented groups] in studies. It makes me want to do more than what they say. If you go to the right school with the right professors, you can definitely do [engineering] and sports."

Team Faults and Kills: Mentorship Mistakes and Successes

Dr. Long: An early and lasting mentorship success I experienced with McKenna involved the level of trust and respect she showed me. Our first success was key, given a long history of mistrust and lies targeting innocent Black men (e.g., Emmett Till, Central Park Five, etc.), when falsely accused of crimes concerning White women (e.g., Amanda Knox, Eleanor Strubing, etc.). Centuries before Dr. Martin Luther King Jr. and years after President Obama, White Americans have also disrespected Black men who meet or exceed moral, educational, and professional standards. My youthful appearance and our proximity in age did not seem to bother McKenna either. Our shared faith in God and middle-class upbringings helped us connect and hold each other accountable when reflecting on our advantages before seeking to serve lower-income groups. Overall, her trust and respect for me allowed us to experience many mentorship successes involving her socialization and apprenticeship as a researcher. McKenna's trust and respect also allowed me to expand my research agenda focused on affirming and empowering more underrepresented people in STEM like us.

Another key mentorship success I had with McKenna was the way we connected our shared interests in sports to a gap in engineering education research. I asked her to review the limited literature on athletes in engineering or related fields and then add sources about career earnings of athletes and

engineers. I shared a sample table summarizing literature with McKenna that I had previously created for a doctoral course. The sample table contained columns for each source's author, title, purpose, participants, context, design/methods, and outcomes/findings. Next, I introduced her to a free site called Canva.com, which my second research assistant had previously found for publishing infographics. Finally, I showed McKenna how to recruit and interview selected research participants. Throughout our mentoring relationship, I treated her like an apprentice by sharing tangible examples and completing research tasks in front of her so she could see how I think and perform.

Although our mentoring relationship consisted of a substantial number of successes, I was unable to secure external research funding after my research start-up funds ended. Although McKenna's very first research task involved helping me tabulate and target a list of external grants, I did not receive funding from the NCAA Innovations in Research and Practice Grant Program until her last semester as an undergrad at ERAU. I believe McKenna's willingness to still volunteer her time caused her to receive more invaluable socialization as a researcher. I was grateful for her consistent contributions and the help of a more senior colleague who was willing to partner with me on the successful grant.

McKenna: Throughout my time with Dr. Long, we experienced numerous successes. Our initial successes were not measured by grants and money, but through transfer of knowledge. Dr. Long educated me on research methods, data collection, and interviewing processes. This transfer of knowledge was successful because I trusted and respected Dr. Long's education, experience, and knowledge. Coming from a military family, my parents enforced the importance of respecting your superiors and elders regardless of race, gender, or age. As my professor, I had immediate respect for Dr. Long; however, this respect and trust constantly deepened through my research experiences with him.

As a White woman, I was initially unsure about questioning Dr. Long on his racial identity and cultural background. I was unsure if he was open to talking about his racial identity, until we developed a deeper relationship. I quickly realized he was open and willing to share personal stories as well as data on widespread systemic oppression targeting African Americans. Dr. Long helped me freely share stories about my experiences as a woman in a male-dominated degree program. I've experienced disrespect, public embarrassment, and belittlement from White male professors which made me hesitate to trust my professors. During my first year of undergraduate studies, I had an exam re-graded in front of the whole class, because my White male professor could not believe I received a better grade than my White male counterpart. From the time when Dr. Long was my professor, he treated me with respect and as an equal, which built trust in our mentoring relationship. Our perceived proximity in age helped build additional trust. I always felt comfortable discussing my ideas with Dr. Long. With more senior professors, I felt my ideas were often perceived as too small and dismissed. Without this overall trust and respect, my mentoring relationship with Dr. Long would not have been as successful.

Another mentorship success we experienced involved our shared research interests. Since we were both interested in underrepresented groups and athletes in STEM, Dr. Long encouraged me to explore the limited literature in this area. After determining gaps in existing research, we developed infographics, performed interviews, and began building a research group to study underrepresented student-athletes in STEM. We identified underrepresented student-athletes in STEM that were passionate about our research and established Team EASE. Dr. Long and I realized the benefits of our mentorship and desired to share these with other underrepresented student-athletes in STEM. Through the development of Team EASE, we were able to dive deeper into our research and share our mentoring benefits. We made research fun and impactful.

Beyond the research Dr. Long and I performed, our mentorship helped me establish self-esteem, maintain academic achievement, strengthen my leadership skills, and identify my career motivation (Mondisa, 2014). Prior to our mentorship, I felt insecure about my abilities as a White woman engineering student. However, Dr. Long's trust and confidence in my research and engineering abilities during our mentorship encouraged me to become confident in myself as a woman in STEM. The research skills I developed and strengthened through our mentorship were beneficial during research assignments throughout my undergraduate degree which helped maintain my academic achievements. By conducting interviews and helping build the research team, I strengthened my communication and leadership skills. Through this mentorship and my experience as a collegiate athlete, I grew confident in my leadership skills and quickly became a leader as an early career professional. Dr. Long always encouraged me to pursue research issues I am passionate about, which helped me identify my career motivations. I have interests in becoming a researcher to continue researching underrepresented student-athletes in STEM. In addition, I am an active member in my company's diversity and inclusion groups, and I created an employee network to help people integrate into the company.

The only failure that occurred in our mentoring relationship was our inability to immediately win an external grant. However, our research team received a prestigious external grant during my final semester. This was more of a challenge than a failure. With or without funding, we produced impactful research and created a team that eventually received compensation for our hard work.

Match Won: Mentorship Model and Team Established

Dr. Long: During McKenna's last year at ERAU, the 2018-19 academic year, our research team was formally established in several ways. Our group decided to create a website and be known as Team EASE. Our research team also changed in size and function. Due to her impending graduation and our growing research involving student-athletes, McKenna recommended I hire her volleyball teammate (a White Hispanic female engineering major). Two Black male non-student athletes in my NSBE chapter decided to join without pay. The first two undergraduate research assistants I hired had left and the third one (a Black female former student-athlete) was volunteering part-time, so McKenna had become my primary and only full-time researcher. Our team now consisted of five undergraduate researchers who were all engineering majors. Besides research on the courses I taught (i.e., scholarship of teaching and learning), my team's two primary research projects involved a study linking sports and STEM as well as a study surrounding Black and Latino males in STEM. Team EASE not only changed in size but also in function. Team members were now responsible for sharing a folder on Google Drive with any files I needed to review (e.g., literature reviews, targeted research participants, subsections of papers or grants, posters, etc.). Members of Team EASE continued to use a site called Canva.com to create infographics from our literature reviews and research publications. We began to communicate more efficiently via an app called GroupMe. I used GroupMe to routinely offer updates and share ideas on an individual or collective basis.

A year and a half after hiring McKenna, days before Mother's Day 2019, I sat in the crowded faculty section of ERAU's largest commencement and clapped loudly as she received her degree. Weeks beforehand, I proudly read an email saying McKenna won a research award from my engineering department. The previous semester, I saw her volleyball team recognize her during Senior Night, their final home game. It was a bittersweet moment. I was grateful for the mentorship model we established. I was also sad to see her leave. Our mentoring relationship led to the formation of Team EASE, which has positively impacted my development as a faculty member and numerous undergraduate researchers. Participation on the team provided us with invaluable experience creating infographics and research posters, delivering research presentations and invited talks, along with securing research grants and personal accolades. Socialization and an apprenticeship approach were key.

McKenna: Working on Dr. Long's research team provided opportunities to grow my research skills, network with peers, and deepen my knowledge of diversity and inclusion. I am now confident in my ability to develop and perform new research. Despite my struggles of being underrepresented in STEM and athletics, Dr. Long's mentorship allowed me to produce research benefiting the next generation. This gave me strength in my highest and lowest moments, because I knew I was helping lead the way for young women who are interested in pursuing athletics and STEM.

During my final year at ERAU, our research team grew in size and strength. The team was large and diverse, from female student-athletes to Black STEM students. Due to our diversity, the team explored the relationship between sports and STEM in a variety of ways. We gathered research, performed interviews, and created infographics to increase awareness of our research. Eventually, the team applied for a prestigious grant and won!

Upon graduation, my departure from the team was difficult. I belonged to two teams during my time at ERAU: Team EASE and the university's volleyball team. Each team had a unique community and relationships, which made leaving them difficult. However, I knew I was leaving the research team in excellent hands. Dr. Long's mentoring techniques helped build a foundation of trust and respect within the team. To watch the research team grow rapidly my senior year was the ultimate prize and farewell gift.

Discussion

Dr. Long: Using an apprenticeship approach, I mentored McKenna for undergraduate research in engineering education (Collins et al., 1987). I helped McKenna improve her communication skills and ability to collaborate on ideas, think analytically and logically, and be self-sufficient (Behar-Horenstein et al., 2010; Ishiyama, 2002). I tried to align my mentoring approach with existing strategies that involved me acting "as a role model and guide for" McKenna while providing guidance on her "academic, personal, and/or professional" pursuits (Mondisa, 2014). I was conscious of McKenna's academic, personal, and professional identities as a woman and student-athlete in engineering. Fortunately, I had previously taught her and I have earned multiple engineering degrees, so I was able to consider her academic needs as a student. My experience co-oping in industry allowed me to also consider her professional needs as an emerging engineer. I relied on our shared experiences in underrepresented STEM groups to connect with her on a personal level.

To connect with McKenna in terms of her identity as a woman, I relied on our shared experiences as underrepresented persons in engineering. As a Black man, I also needed cross-cultural sensitivity in mentoring relationships (Mondisa, 2014). I could relate to her feelings of underrepresentation or being one of the only members of her identity group in engineering (Strayhorn et al., 2003). We acknowledged my male privilege and her White privilege. For example, my male privilege helped me survive in a male dominated field even though racism (McGee & Martin, 2011) still made it extremely difficult. On the other hand, McKenna's White privilege provided her with social capital in engineering although sexism (Smith & Gayles, 2018) made it very unwelcoming.

To connect with McKenna in terms of her identity as a student-athlete, I empathetically listened to the uncontrollable time constraints and expectations she faced. I also became increasingly sensitive to the role that athletic scholarships play in a student's decision to compete in a collegiate sport. During my candid discussions with McKenna, I had to face the realities of how a tuition-based academic scholarship influenced my decision to stop playing sports before college. My tuition-based academic scholarship created a form of financial relief and economic privilege in college, similar to her athletic scholarship.

Like McKenna, I recognized the importance of symbolism (e.g., gender, race, athletics) (Mondisa, 2014). So, I asked her to create infographics that included female student-athletes and professional athletes from STEM fields. I had her review some research papers that were written by females. I wanted her to gain exposure to more female role models. I wanted her to be confident as a researcher.

To provide research guidance, I utilized modeling, explanation, coaching, scaffolding, reflection, articulation, and explanation (Collins et al., 1987; Dennen & Burner, 2008; Enkenberg, 2001; Savery & Duffy, 1995). I modeled my process of thinking about research by scheduling in-person meetings with McKenna, collaborating on virtual documents with her, and by giving her access to my previous publications. One early tool that proved especially helpful for allowing me to demonstrate the process of thinking through literature reviews was a sample table summarizing literature I previously created for a doctoral course. My in-person meetings with McKenna not only allowed me to model my process of thinking about research to her but they also allowed me to explain why research activities take place as they do. The collaborative documents (e.g., Google Docs, Canva, etc.) I shared with her allowed me to provide coaching as well, while monitoring her research activities and assisting where necessary. Fortunately, cloud-based software for collaborative documents allowed me to insert comments, track changes, and make edits.

As McKenna developed more research skills, I provided progressively less support based on her needs. Next, she began to self-assess her literature review tables, infographics, ability to recruit research participants, and lead interviews. She later explained her research activities and artifacts to other members of our research team. Lastly, McKenna and I took a similar approach to complete new but similar research tasks. Overall, our mentoring relationship helped us both succeed as underrepresented persons in STEM (Fries-Britt & Kelly, 2005).

McKenna: My mentoring relationship with Dr. Long was successful due to our described apprenticeship process. Since my in-person interview, he made a conscious effort to connect with me on a personal level. Although Dr. Long and I are not the same race or gender, we share similar interests and some experiences as underrepresented people in STEM. During our regularly scheduled in-person meetings and email correspondence, he always encouraged me to pursue topics for which I had a deep interest. His “coaching” helped me establish myself as a researcher (Linn, 2015) since I had no prior research experience besides educational research reports.

Dr. Long made tremendous effort to support any challenges that arose for me as a student-athlete. He was always understanding if a meeting was rescheduled or a deadline had to be changed. Although education was my main priority, my volleyball team was a close second. I relied heavily on both an academic and athletic scholarship to pursue my college education. As Dr. Long mentioned, we were both raised in middle-class families. So, we each received financial support from parents for “hidden” college fees; but any additional form of financial relief was highly important to both of us. We did not take our financial situations for granted. We had a shared desire to use our platforms and economics to support students from under-resourced communities. We wanted to “pay it forward.”

Although Dr. Long was not a woman, he routinely made an effort to connect our shared experiences as underrepresented persons in engineering. As a woman, it was challenging to find my identity as an engineer. Dr. Long could often relate to these feelings as a former underrepresented student in engineering. We were aware of our unique privileges as a White person and male, while still being sympathetic of individual struggles.

To grow my knowledge of collegiate athletes who majored in STEM, Dr. Long tasked me with creating infographics to educate and inspire youth. This assignment gave me an opportunity to review

research papers and articles about student-athletes in STEM. Reading relevant articles helped me see how unique student-athletes in STEM are, particularly women. From this research, I wanted to spread "the word" about the possibility of pursuing both sports and STEM, for the next generation of underrepresented groups in STEM. I knew "symbolism" mattered.

During our mentoring relationship, Dr. Long utilized multiple methods to develop and improve my research skills. We mainly focused on improving my communication skills along with my ability to collaborate on ideas, think analytically and logically, and be self-sufficient (Behar-Horenstein et al., 2010; Ishiyama, 2002). He would schedule in-person meetings to review my assignments, discuss his previous publications, and plan future assignments. Dr. Long and I collaborated on virtual documents so he could monitor my research activities, answer my questions, and review my work. The virtual environment also allowed him to share previous publications and example work. I used them alongside my own research. His virtual and in-person explanations were key.

As I progressed in my research skills, Dr. Long encouraged me to self-assess my progress. During my senior year, I developed interview questions, recruited participants, and eventually led interviews that have been included in a research poster. I also educated other members of our research team on my activities. I believe we've both benefited greatly from our mentoring relationship, which still exists today.

Conclusion

Limited work focuses on mentoring of underrepresented STEM students. Much less attention has been given to mentoring of underrepresented STEM students or student-athletes in research settings. Within many STEM fields, women and other racial-ethnic groups (i.e., Blacks, Latinos, Native Americans) have historically been underrepresented at the faculty and student ranks (Myers, 2016; NSF, 2016). As a result, underrepresented STEM students have had reduced opportunities for peer or faculty mentorship from individuals with similar gender, racial, or ethnic groups (Mondisa, 2014).

Using critical CAE, we revealed our unique insights about mentoring a student-athlete in STEM for undergraduate engineering education research. We shared our personal narratives of how this mentoring relationship led to the formation of Team EASE, which has impacted the development of a faculty member and numerous student researchers. Participation on Team EASE has provided us with invaluable experience creating infographics and research posters, delivering research presentations and invited talks, along with securing research grants and personal accolades.

This dialogue paper highlights a potentially overlooked strength of Black men who are engineering professors. With sufficient financial resources from the institution, Black men can successfully serve as research mentors to various underrepresented groups in engineering, including women and student-athletes. These findings show how Black men can have successful careers as faculty members in areas that interests them, such as engineering. Furthermore, women and student-athletes can have rewarding undergraduate research experiences with Black men in engineering.

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