© *Journal of Higher Education Outreach and Engagement*, Volume 22, Number 2, p. 127, (2018)
 eISSN 2164-8212

"We Don't Leave Engineering on the Page": Civic Engagement Experiences of Engineering Graduate Students

Richard J. Reddick, Laura E. Struve, Jeffrey R. Mayo, Ryan A. Miller, and Jennifer L. Wang

Abstract

Few scholars have examined the civic engagement experiences of graduate students in engineering fields. To address this void, this study uses social exchange theory and experiential learning theory to consider the experiences of engineering graduate students in service programs at a predominantly White research university. The findings suggest that students are highly motivated to serve and derive complex meaning-making from their service, thus advancing understandings of how engineering graduate students find meaning in civic engagement. Although engineering graduate students may be expected to focus primarily on research and professional advancement, our findings suggest there is an opportunity to more fully involve students in civic engagement activities.

Keywords: graduate students; engineering; civic engagement; community service

Introduction

Growing student interest in community engagement and service-learning is widespread across institutions of higher education, as demonstrated by the surge in creation of service-learning and experiential learning programs (e.g., Engineering Without Borders) over the past decade and a half *(May, 2017)*. Graduate students are no exception to this rising interest, yet graduate education continues to train scholars with traditional narrowly focused academic goals and areas of expertise *(Franz, 2013; Matthews, Karls, Doberneck, & Springer, 2015; O'Meara, 2011)*. Graduate students, including those interested in community-based engagement or research, are socialized to be scholars and researchers *(Austin, 2002; Gardner, 2007, 2010; Golde & Dore, 2001; O'Meara & Jaeger, 2006)*. Furthermore, graduate students lack access to faculty members and advisors who encourage deviating from these cultural norms to pursue civic engagement *(Franz, 2013)*. This presents a challenge for graduate students pursuing civic engagement, as well as higher education programs intending to support such interests.

Community-based activities provide significant social and professional benefits to students who participate in them *(Laursen, Thiry, & Liston, 2012; Wallen & Pandit, 2009)*, as well as the communities in which they serve *(Gergen, 2012)*. These benefits include fostering persistence, gaining soft skills (e.g., interpersonal communication), feeling emotionally connected, and stimulating economic growth *(Gergen, 2012; Greenwood, 2007; Nasr, 2014)*. Considering these benefits and the potential impact on student programs, communities, and the U.S. economy, research exploring civic engagement is warranted.

The policy and higher education communities have emphasized research related to undergraduates in the areas of science, technology, engineering, and mathematics (STEM). President Obama charged higher education institutions to produce one million more STEM graduates over the next 10 years; during his presidency, he detailed efforts to support more STEM-focused high schools and districts, improving STEM education at community colleges, and identifying best practices to engage youth and adults in STEM *(WHOSTP, 2013)*.

Existing research on undergraduate student civic engagement is substantial, and a growing body of recent research has evaluated graduate student civic engagement *(Austin & McDaniels, 2006; Latimore, Dreelin, & Burroughs, 2014; Laursen et al., 2012; Matthews et al., 2015; O'Meara, 2008a; O'Meara & Jaeger, 2006)*. Within this body of research remains a need for further study on graduate STEM student involvement in civic engagement, especially within fields like engineering. However, there is a lack of research into graduate students' motivations for pursuing civic engagement work. A greater understanding of such motivations is needed to better support the engagement interests of graduate engineering students and graduate engineering programs.

As educators and administrators, we need to consider the ways in which our knowledge of graduate students' civic engagement efforts (defined as the various volunteer, outreach, and service activities in which these students elect to participate) intersects with this pressing need for STEM graduates. Institutions like the University of Texas at Austin and Northwestern University have civic engagement centers across disciplines, including STEM, but there is a need for scholarly inquiry to advance understanding of how these experiences shape students' academic and civic engagement meaning-making. Considering the vast scope of disciplines within STEM, our research team sought to understand the underlying motivation for graduate engineering students' involvement

in civic engagement, as well as how they made meaning of their service activities, through the following three research questions:

1. How do engineering graduate students at a research university describe their motivations to become involved in civic engagement opportunities?
2. How do engineering graduate students at a research university discuss their respective civic engagement behaviors?
3. How do engineering graduate students at a research university make meaning of their civic engagement and discuss its influence on their futures?

Literature Review

Civic Engagement and STEM

Although not as transparently well suited for civic engagement as some other academic fields (social work and education, for instance), STEM remains a viable area of inquiry where civic engagement has positive outcomes for students and community. In this study focused on graduate engineering students, we also highlight the broader literature on civic engagement and graduate students in STEM both because less work is available on engineering and civic engagement specifically and because findings from the engineering context may potentially translate to other STEM disciplines. Although civic engagement has been incorporated into many disciplines, it has not been as widespread in STEM fields *(Butin, 2006)*. Increased attention on the role of science and engineering fields regarding outreach and community engagement has encouraged the establishment of centers to address these needs. For instance, the Center for the Integration of Research, Teaching, and Learning (CIRTL) leverages graduate education as a point of entry for improving learning and diversity in STEM fields and now has over 40 U.S. university partners *(CIRTL, 2016)*. Science Education for New Civic Engagement and Responsibilities (SENCER) aims to make "science more real, accessible, 'useful,' and civically important" *(SENCER, 2016, para. 2)* by supporting faculty development programs; creating resources like model courses, research, and assessment; and promoting those who perform this work. At Purdue University, in the Engineering Projects in Community Service (EPICS) program, undergraduate students earn academic credit for community-based service-learning engineering design projects. EPICS enrolls almost 400 students per semester who are involved in 80–90 projects at a time *(Coyle, Jamieson, & Oakes, 2005)*.

Research has demonstrated how civic engagement models from these centers can be directly applied to undergraduate STEM curriculum efforts *(Fredeen, 2012; Ritchie & Tait, 2016)*; teaching and learning strategies in STEM fields *(Fink, 2009; Smith, Clarke Douglas, & Cox, 2009)*; and engineering student perceptions of the value of engagement efforts *(May, 2017)*. Scholarship regarding undergraduate engineering students' engagement has focused on developing "21st century" professional skills in cocurricular involvement *(Fisher, Bagiati, & Sarma, 2017)*, community service-learning *(Coyle et al., 2005, 2006)*, number of hours on cocurricular activities *(National Survey of Student Engagement, 2012)*, and definitions of engagement *(Heller, Beil, Dam, & Haerum, 2010)*. Goggins *(2012)* discussed a multitude of civic engagement and service-learning engineering courses at the National University of Ireland at Galway, stating that having these learning opportunities "gives students the flexibility to further explore areas that interest them, while gaining experience of working in a small team with community partners on 'real' projects" *(p. 248)*. Such opportunities align with Boyer's *(1996)* engaged scholarship and Sullivan's *(2005)* civic professionalism.

Graduate Students and Civic Engagement

Doctoral students are socialized to the norms and practices of attaining faculty positions at research institutions, especially in the STEM disciplines *(Austin, 2002; Gardner, 2007, 2010; Golde & Dore, 2001)*. Thus, their training and preparation emphasize research over other components of scholarly life, like service *(Golde & Dore, 2001)*. At research universities, activities like community engagement or research that has a public purpose are considerably underrewarded; graduate students are therefore discouraged from pursuing similar types of work. O'Meara *(2006)* explained, "graduate students do not learn to 'see' community engagement as a way of being a scholar" (as cited in *O'Meara & Jaeger, 2006, p. 14*). As graduate students are further socialized into the role of scholar, they do not prioritize, and, in many cases, are discouraged from pursuing community engagement practices *(O'Meara & Jaeger, 2006)*. Although much of the work on civic engagement focuses on undergraduate education, a substantive strand of scholarship examines the impact of civic engagement and service/outreach activities among graduate students *(Austin & McDaniels, 2006; Latimore et al., 2014; Laursen et al., 2012; Matthews et al., 2015; O'Meara & Jaeger, 2006)*.

One study found that graduate science and engineering students who served as science outreach educators experienced positive outcomes, including enhanced professional identities *(Laursen*

et al., 2012). Cherwitz and Sullivan *(2002)* discussed how STEM graduates collaborated with humanities scholars to develop "story telling techniques that will enhance the scientific literacy of students" *(p. 24)*. They pointed to a further advantage of civic engagement—which they term "intellectual entrepreneurship" (IE)—namely, that such opportunities allow graduate students in STEM areas to combat self-doubt and chart their own futures in the field:

> In the words of one engineering graduate student, IE allows "students to re-empower themselves, so they can get back control over their own education, their own future." A good example of this re-empowerment is a Ph.D. in mathematics. Although his advisor preferred that he take a postdoctoral position at a prestigious research university, this graduate chose to accept a faculty position at a small liberal arts college where he could pursue his first love—teaching. *(Cherwitz & Sullivan, 2002, p. 26)*

Undergraduate STEM fields have been late in building civic engagement into their disciplines, but they have made increasing investment in and commitment to mentoring and tutoring, as well as enhancing persistence and engagement among students. Further, STEM students and graduates enhance interpersonal and community-based communication via these civic engagement opportunities. Although much of the research examining the benefits of civic engagement, volunteerism, and service-learning has centered on undergraduate students, an emerging focus in the literature has been the impact and effect of civic engagement for graduate students in the STEM fields. Our inquiry seeks to expand this area by examining how engineering students in graduate school conceptualize and understand their civic engagement.

Mentoring, Civic Engagement, and STEM Fields

Given that college students are so invested in mentoring and tutoring, it is important to understand what impact these activities have on STEM, an academic area of need. The paucity of STEM majors, particularly from the populations of underrepresented minorities and women, has been documented and chronicled at length (see *Tsui, 2007*, for a comprehensive review). Experts identify mentoring as one of the most effective methods of increasing interest and sustaining persistence in STEM fields *(Ginorio & Grignon, 2000; Solórzano, 1993; Tsui, 2007)*. Similarly, tutoring has

been recognized as a "long-standing aid in student learning, and is widely used today as an intervention measure to enhance student performance and persistence" *(Tsui, 2007, p. 562)*.

Civic engagement via service-learning is a method of linking academic inquiry with the needs of a community and society *(Goggins, 2012; Zlotkowski, 2007)*. In a study of engineering students in Ireland, Wallen and Pandit *(2009)* found that the student engineers' engagement in community-based activities enhanced the participants' soft skills. This is essential in STEM fields such as engineering, as practitioners must simultaneously demonstrate an ability to keep their skills current while interfacing with and working in a changing societal context *(Greenwood, 2007; Nasr, 2014)*. These benefits not only improve outcomes for STEM students but also enhance the communities in which they serve. Volunteers become emotionally connected to the communities they serve and can sustain community involvement even after their term of volunteering, which is a strong indicator for economic growth *(Gergen, 2012)*.

Motivations for Graduate Students' Civic Engagement

Graduate students, especially those who aspire to be faculty members, are socialized away from pursuing service or community engagement work, which generally goes unrewarded at research universities *(O'Meara, 2008b; O'Meara & Jaeger, 2006)*. O'Meara *(2008b)* explored faculty members' motivations for community engagement, an area that offers insight to graduate students who are being socialized to potentially become faculty members. O'Meara *(2008b)* found both intrinsic motivators (e.g., enhancing student learning, acting on personal commitments to specific issues, pursuing rigorous scholarship, desiring collaboration) and extrinsic motivators (e.g., fulfilling institutional and context-specific commitments) for engagement. Intrinsic motivators "that had to do with [faculty members'] own sense of personal and career goals" *(O'Meara, 2008b, p. 23)* were more commonly evidenced than extrinsic motivators. Although academia does not typically reward such engagement, prospective faculty also desire to engage in work that provides meaning and has an impact on society *(Austin, 2002)*. Graduate students have a considerable amount of "pre-existing knowledge, experience, commitment to continued education, and relative maturity" they can contribute to communities *(Levkoe, Brail, & Daniere, 2014, p. 71)*. Some graduate students see civic engagement as a way to make these connections between their scholarly work

and the real world *(Cherwitz & Sievers, 2003)*. Others hope to continue their undergraduate engagement work during their graduate careers, as they derive personal meaning and inspiration from this work *(Golde & Dore, 2001; O'Meara, 2008a)*. Missing from the literature is a nuanced view of their motivation for civic engagement activities and the meaning they derive from this work.

Theoretical Framework

In this study, we analyzed the civic engagement experiences of graduate students in the engineering fields. Theories that address both motivation and meaning-making associated with civic engagement are essential to understanding their experiences. To this end, we utilized social exchange theory *(Emerson, 1981; Homans, 1958)* and Kolb's *(1984)* experiential learning theory to direct our inquiry.

Social Exchange Theory

Social exchange theory assumes that individuals are self-interested actors who, in order to accomplish their goals, transact with other self-interested actors to gain access to resources in order to accomplish goals they could not achieve alone *(Emerson, 1981; Lawler & Thye, 1999)*. According to social exchange theory, individuals enact a cost-benefit analysis of forming, maintaining, or terminating relationships based on the perceived ratio of benefits to costs in the relationship *(Emerson, 1981)*. A central component in social exchange theory is the norm of reciprocal exchange. Individuals both give and receive benefits within a relationship. Interactions that include sequential giving may be bound by unspecified terms or obligations; however, each actor has motivation to fulfill the exchange *(Emerson, 1981)*.

Social exchange theory has been applied to investigate undergraduate and faculty STEM research involvement *(Eagen, Sharkness, Hurtado, Mosqueda, & Chang, 2010)*, mentoring in the context of higher education *(Griffin, 2008; Reddick, Griffin, Cherwitz, Cérda-Pražák, & Bunch, 2012)*, and undergraduate students and civic engagement and volunteering *(Bringle & Hatcher, 2002; Sergent & Sedlacek, 1990)*; however, there is a dearth of literature integrating social exchange theory and civic engagement specifically in the context of STEM majors.

Experiential Learning Theory

Kolb's *(1984)* experiential learning theory (ELT) draws from classical theories of human learning and development that were developed from the work of influential scholars like John Dewey, Kurt Lewin, and Jean Piaget. In an effort to integrate previous theoretical work regarding cognitive and socioemotional factors in learning, and to link theory with practice, Kolb *(1984)* created a four-stage cyclical model, the experiential learning model. At one end of the first dimension is the concrete experience, in which the learner is actively engaged in a task or experience, and at the other, the abstract processing of events and synthesizing of experience with knowledge. One end of the second dimension includes reflective, scrutinized observations of knowledge and experience, which is balanced with practical experimentation applying theorized abstract concepts on the other end *(Kolb, 1981)*.

ELT's applicability is interdisciplinary; over 1,000 studies have utilized ELT in fields including management, education, information science, medicine, nursing, accounting, and law *(Kolb & Kolb, 2005)*. Reviews of experiential learning in engineering fields widely cite Kolb's cycle model of experiential learning *(Verner & Ahlgren, 2004)*. As community-based action research gains prominence in STEM fields, additional inquiry into student motivation and outcomes is warranted. Chang, Wang, Chen, and Liao *(2011)* investigated an action-based service-learning collaboration between engineering students and a nongovernmental organization, finding that students were able to create meaning in their course material, enhance self-motivation and empathy, and develop academic goals appropriate for their career goals in relation to civic engagement initiatives. In an effort to capture our participants' respective motivation for civic engagement and their reflections and constructions of their involvement, we connected these theoretical frameworks to guide our inquiry.

Methodology

As researchers, we sought a methodology that afforded the ability to gain rich descriptions of engineering students' perceptions and explore the meanings and interpretations given to specific decisions, events, and motivations (Miles & Huberman, 1994). With these criteria in mind, we selected a phenomenological approach to our research query. As phenomenological researchers, we were concerned with understanding social and psychological phenomena from the perspectives of the people involved *(Welman*

& Krueger, 1999, p. 189). Our task was to describe as accurately as possible the phenomenon of the participants' motivation for civic engagement and their reflections on their activities, remaining true to the facts as the participants understood them *(Groenewald, 2004)*. Our model was derived from Seidman's *(2006)* structure, which provided context (making the participants' behaviors meaningful and understandable), allowed participants to reconstruct the details of the phenomenon of civic engagement, and encouraged the participants to reflect on the meaning the experience contained for them. This approach allowed us to obtain the "universal essence" *(Creswell, 2013, p. 76)* of participating engineering graduate students in service programs at a predominantly White research university.

We focused on the motivations that led graduate students in engineering fields to become civically engaged. The participants in the study were engineering students in two faculty-led research groups concentrating on sustainability issues in an energy subfield. Data were collected through a series of phenomenological in-depth interviews covering a wide array of topics, including formative experiences with community service, familial influences on volunteerism, and thoughts about how civic engagement would direct future experiences.

This study took place at a selective public institution in the southwestern United States. A public flagship university, it is classified as a doctoral university with highest research activity *(Carnegie Classification of Institutions of Higher Education, n.d.)*. Twenty respondents completed a survey distributed by researchers after securing Institutional Review Board approval. The survey served to recruit research participants, confirm study eligibility, and gather participant demographic data. Of the survey respondents, a subset of eight students (Table 1) were interested in participating in the study's in-depth phenomenological interview process *(Seidman, 2006; van Manen, 1990)* and were scheduled accordingly. The interviews addressed their life histories (past civic engagement, influence of family) and their volunteer and outreach experiences in depth (perceived value of community service, costs and benefits of committing time and energy to these endeavors). This information is summarized in Table 2.

Table 1. Participant Overview

Participant	Degree	Department	Age	Gender	Race/ Ethnicity
Cara	Ph.D.	Civil Engineering	31	Woman	Asian
Matt	Ph.D.	Mechanical Engineering	30	Man	White
Ashley	Ph.D.	Civil Engineering	26	Woman	White
David	Ph.D.	Chemical Engineering	26	Man	Hispanic
Abby	M.S.	Environmental and Water Resources Engineering	24	Woman	White
Molly	Ph.D.	Materials Science and Engineering	24	Man	White
Elizabeth	M.S.	Mechanical Engineering	31	Woman	White
James	Ph.D.	Mechanical Engineering	26	Man	White

Table 2. Participants' Graduate School Engagement Activities

Participant	Current Engagement			
	Mentor for undergraduates	K-12 outreach	Women in Engineering	Other
Cara		x		
Matt	x	x		
Ashley	x			Engineers Without Borders
David		x	x	
Abby		x		
Molly		x		Religious ministries
Elizabeth	x	x		Habitat for Humanity; food banks; youth robotics competitions
James		x		Community energy audits; HS curriculum development

Each 60- to 90-minute interview was audio recorded and transcribed. This approach was selected to explore the phenomenon of engineering student volunteerism and outreach, despite perceptions that service is less valued than research in these fields *(Antonio, Astin, & Cress, 2000)*, and to understand how these students personally make meaning from these experiences. As phenomenology focuses on the lived experiences of participants to extract the

essence from a shared phenomenon *(Creswell, 2013)*, this approach aligns with the purpose and scope of this study.

The analysis of this data was informed by the aforementioned theories on social exchange and experiential learning, but also integrated emic coding to understand fully the motivations, costs, benefits, and meaning-making associated with service and outreach. In this stage of analysis, researchers reviewed transcripts from interviews using an open coding process *(Strauss & Corbin, 1990)*, capturing unique aspects of the civic engagement experience from the perspective of engineering students. Sample open codes included *priorities*, *populations served*, and *family*. In subsequent coding stages, the researchers noted common themes and individual differences in the ways students are motivated to volunteer and how they interpret the cost-benefit analysis of social exchange.

Trustworthiness and Triangulation

To minimize threats to validity and trustworthiness, we employed many strategies in the qualitative tradition *(Creswell, 2013; Johnson, Rose, & Schlosser, 2007; Kvale, 1996; Seidman, 2006)*. We triangulated findings by using a team approach to this study and employing several data collection methods and sources to address interpretive validation *(Ritchie & Ormston, 2014)*. Specifically, we drew on data from our initial participant survey, one-on-one interviews, and review of documents. Documents included websites and background literature about the civic engagement programs structured for engineering graduate students at the university under study. We also drew on the curriculum vitae of the study participants, allowing us to ensure that we captured their past and present activities. Furthermore, members of the research team wrote analytic and reflective memos about each interview, read transcripts, and coded independently, providing opportunities to challenge findings and assumptions and present alternate interpretations. To bolster credibility, participants in this study were given the opportunity to verify comments in their interview transcripts *(Creswell, 2013)*.

Findings

Participants identified different paths to their current civic engagement interests and efforts, but common themes emerged regarding both their underlying motivation in civic engagement and their meaning-making of these service activities. We focus on four findings regarding these students' civic engagement efforts:

prior engagement, professional cost/benefit of investment, communication skills, and paying it forward.

Prior Engagement

As a group, student participants in this study established themselves as civically engaged volunteers many years prior to graduate school. Participants' prior experiences profoundly shaped the ways that students chose to continue participation in civic engagement opportunities. For some, civic engagement was mandatory (e.g., as a requirement in a private school). For others, civic engagement was modeled by their family members and their experiences throughout childhood, adolescence, and college. Their respective backgrounds influenced their decisions to prioritize engagement opportunities during graduate school. All but one participant discussed growing up in a family environment that included volunteering. Participants described being required to participate in community service as youths. Parents, involvement in a religious institution, and school requirements were the most common sources prescribing community service. Participants shared that they volunteered for other reasons or went above and beyond any requirements.

Cara made the connection between prior work in communities with her current civic engagement as a graduate student very clear. At age 13 and encouraged by her mother, she volunteered at a zoo, in a hospital, and in soup kitchens. "My mom, actually, always encouraged me to volunteer. . . . I think she wanted me to see what life is like outside of my immediate environment." In addition to family encouragement to volunteer, Cara admitted that such activities could also advance one's resume. Prior to starting graduate school, her advisor described mentorship and volunteer opportunities:

> He mentioned that [the program] does a lot of outreach activities, such as speaking at [schools] and getting involved in all these activities. And I thought, "Oh, this is something that I've always done." You know, I'm still kind of doing it.

While in college, Cara became involved in the Society of Women Engineers, initially to seek support from and connections with peers, but eventually to continue her engagement with mentoring and seeking to encourage women to pursue engineering.

Elizabeth described extensive participation in service activities influenced by church, family, and, as an undergraduate, through membership in a sorority and as a peer mentor. She traced this involvement to her family:

> The sense of community in my family is very strong. So the most important things in our lives are relationships and community engagement and volunteering. It's about building relationships in the community and that makes us all stronger, so that's a thing in my family.

Another student, Molly, attended a school that required service, but she also chose to dedicate more hours than needed:

> So I went to a private school where community service was mandatory. In order to get your grades for the year, in order to graduate, you had to accumulate, I think, it was like 80 hours of community service. My parents definitely encouraged me to go a little bit beyond the mandatory 10 hours per year, or whatever it was.

Molly's mother also set an example by volunteering in the community.

In addition to family influences, five of eight participants discussed volunteering through church or religious groups, and three were involved in scouting while growing up. David shared that service was part of his religious identity:

> I think it's an actual part of the moral system that came with also attending church. So, we were Latter-Day Saints, and so it's a tenet of our faith to give back, charitably, to others. And, so, even though my parents didn't necessarily formally say, "You need to perform this many service hours a week," or month or whatever, but I was always encouraged to be mindful and to participate.

Initial involvement in scouts or church groups often gave way to volunteering (with or without other family members) in local social and community causes, including the environment (e.g., beach or river cleanup), homelessness (e.g., soup kitchens), and education (e.g., mentoring children or volunteering at a library). In addition, some participants remained involved in civic engagement activities through student organizations during their high school and under-

graduate years. One student, Ashley, described heavy involvement in service and volunteer activities:

> When I was really little, we used to, like, go do stream cleanups or walk around the neighborhood and pick up trash or . . . volunteer in the library, or I mean anything that you can think of, we probably did something like that. And then when we got a little bit older, we would go like on trips, and help build houses, or help tutor kids in the library, or we worked at like nursing homes, and so many things. So, yes, it's been a part of my life for a long time and I feel really strongly about it, that it's important not just for me, but other people that have the benefit of a lot of things that other people don't.

For Ashley, sources including family, church, scouts, and school groups influenced her orientation to civic engagement and service, an experience echoed by a majority of participants encouraged to serve through multiple influences.

Professional Cost/Benefit of Investment

Although these pre-graduate-school activities influenced their decisions to remain connected to outreach opportunities, the participants differed in their views on whether their continued civic engagement was a professional cost or benefit. The majority of students in the study recognized that their engagement came at a cost, which most often meant the loss of time—a valuable commodity for graduate students. Many of these participants weighed the opportunity cost of dedicating time to civic engagement over academic pursuits. Elizabeth shared her observation that within the academic STEM community, service should not come at the expense of research:

> As long as it doesn't interfere with your research, they love it, they think it's great. It's good for your community, they support it. It looks good for them as well, so it's everybody wins as long as you're not sacrificing your research and your work.

Elizabeth found that some of her professors would justify her service as "winky-winky, 'selflessly'" motivated networking opportunities, even though she believed her motivations were typically altruistic. Such comments led the participants to feel that their

service would be valued only as a supplement to, but never as a replacement for, research and academic work.

The students in the study who viewed their community service as a cost often described an inability or apathy toward keeping up with academic or professional expectations. Molly, who volunteered time to engineering outreach in the local community, described how the strain on her time postponed her expected graduation date:

> I recently quit [engineering outreach] in March because it was just getting to be too much, and I needed to actually finish my thesis. I'm a dual degree student, so my program is three years, but I'm in my fourth year right now. So I'm an extra semester late. Not just because I was doing stuff at the same time. I interned—[I'm in my] fourth internship right now, but essentially you're just learning that I do too much.

When she decided that her obligations were too great, Molly elected to step away from service, rather than accept a fourth internship that provided professional experience.

Elizabeth shared Molly's view that service would prevent her from meeting professional expectations, but she described indifference toward the perceived shortcomings:

> I will never be a "100-hour per week on a paid thing" kind of person because that means that I can't give back to my community, I can't give back to my family, and I can't give back to myself. I'm never going to be that person, that's just not who I am. I'll work 100 hours a week, but it'll be on a multitude of things, only 40–50 hours on my "job."

She felt her community service revitalized her: "I will be more productive, and you will get more positive amazingness out of me, if I have the freedom to go to Honduras and build five homes. I'll be better." Though Elizabeth acknowledged that service would take time away from her career, she would return personally fulfilled and prepared to work.

Though a minority of participants, a substantial subset of students in the study described the time spent on community service as a direct professional benefit. Consistent with the norm of reciprocal exchange *(Emerson, 1981; Lawler & Thye, 1999)*, participants

recognized the potential for professional advancement or formal recognition tied to helping others. David made a direct tie between service and outreach to populations underrepresented in STEM and funding opportunities:

> When they do this, they are doing it in the best of conscience, but I also know that a lot of the funding sources, such as the NSF [National Science Foundation], encourage outreach and then they give, in the subtext, bonus stars if it's girls and minorities. I think there's an incentive from funding sources.

Though not the entire motivation for civic engagement, the advantage in the competition for funding did not go unnoticed.

The majority of participants also stressed the ways in which the benefits from service and outreach differed from the benefits derived from research. For Abby, whose research focused on water and energy matters, giving back to the community provided the immediate gratification of knowing she had a positive effect on people's lives:

> For me personally, my research goals have always been very, very long term. I'll be really, really happy if I see some sort of turnaround in my lifetime as a result of the research that I've done. That would be really fantastic, but I'm looking on the scale of my lifetime, so [community service and outreach] is kind of providing me with a really nice opportunity to feel like I'm having an impact now. There's definitely a little bit of frustration kind of building up where I was. I didn't feel like I was doing anything. At the end of the day, not everyone can do what I'm doing and I am contributing, but it felt too slow, and so it's kind of nice to feel an immediate impact.

Though research and the application of findings is an often long and arduous process, direct work with the community brought Abby instant satisfaction. James, a master's student from a different research group on campus, described such "small victories" as the immediate benefits that he needed to stay motivated along the path to more substantial professional payoffs in the future.

Communication Skills

In addition to the intrinsic value, several participants also indicated that their civic engagement activities led to improved communication skills. Many of the participants noted the ease of their public speaking was attributable to the types of outreach initiatives they were involved in, reporting that they spoke to a variety of audiences, sometimes including large crowds. With regard to public speaking—a skill many participants noted as crucial to bridging the STEM community with the general public—participants' descriptions of their outreach and service aligned with the four stages of ELT: concrete experience, observation and reflection, formation of abstract concepts and generalization, and testing implications of concepts in new situations *(Kolb, 1984)*.

Several participants described how speaking to a diverse audience and lay people enhanced their ability to effectively communicate their research. Cara, an engineering doctoral student, reflected on her ability to communicate broadly:

> How do you communicate to a younger audience? How do you communicate to a slightly older audience? How do you have a one-on-one conversation that's, you know, specifically focused on one person versus presenting to, like, a—room of 300 people? These are all sort of maybe soft skills that research sometimes doesn't bring. . . . Like, sometimes you forget because you're in a field and only talking to people who are experts in the field, and you see, "Everybody knows this, right? It's common knowledge."

It is these kinds of soft skills that cannot be taught in the laboratory or classroom that these students refined with their civic engagement activities.

Participants acknowledged that these opportunities looked good on one's resume and also served as specific examples of skills that, although valued by employers, may not necessarily be acquired through course offerings. Abby noted how these civic engagement events forced her to interact with a variety of people, something that she was previously uncomfortable with and had little confidence doing. As her time in the field progressed, she felt greater comfort interacting with different people, and this has helped her move forward in many facets of her life. Cara suggested that graduate students are well situated to communicate with and generate excitement in younger students, sharing that faculty are

not quite as relatable and graduate students are "better qualified or have more to bring to the table than some of the undergraduate volunteers." As a graduate student, she felt approachable and had the confidence of an emerging expert in her field.

Finally, Molly articulated how these communication skills, in addition to their practical value, served the greater good:

> We are people that don't leave engineering on the page and the journal. That's not what we're necessarily writing for. Like that's important to communicate to the scientific community, but—and it's really easy to just do that—but like outreach lets you go beyond that and make sure that you are still able to communicate to people that aren't just engineers.

In addition to aligning with the four stages of Kolb's *(1984)* model of experiential learning, these instances of improving communication skills reflect tenets of social exchange theory as well. Participants both gave (disseminated knowledge and engaged with diverse communities) and received benefits (improved soft skills like speaking to a lay audience) from their civic engagement efforts.

Paying It Forward

Ultimately, participants recognized that involvement in these various outreach efforts could positively influence others, just as others had done for them, in a "pay it forward" approach. Matt stated, "I felt like I wanted to give back and keep that opportunity available, and even provide more opportunities for the people behind me. And so, I would be involved in trying to make sure that those things kept going." Several participants, both men and women, remarked how this "pay it forward" idea was especially important for women in engineering, as they are still underrepresented in STEM fields. Ashley recalled:

> I mean, for me, the Women in Engineering Program . . . especially, was, like, instrumental in keeping me in engineering because I probably would have quit in the beginning. . . . . probably the first year or two. But, I think that was really important for me to stay there, so I kind of like to give back if I can.

Five out of the eight participants were women, and each woman reflected on the importance of a mentor or outreach ini-

tiative in piquing their interest in STEM and then maintaining it. One participant, Cara, identified the importance for her of paying it forward and building awareness for a future generation of women engineers, as one woman did for her. She noted that in a male-dominated field like engineering, many of her women peers had fathers or other male role models who were engineers, but for her it was a woman college student who spoke to her high school class about majoring in engineering. Cara stated:

> Most girls who don't grow up with parents in one of these fields don't even realize that this is, like, a possibility for them. . . . I think it's important for [girls] to be able to consider that because I actually didn't know what engineering was until someone from—I still remember this. She was an industrial engineering major, and she came and talked to my high school calculus class about engineering. And I thought, "I've never heard of this field," you know, like, "What is this?" And it was fascinating, and I started researching it, and I ended up being in it.

Even the women who thought they could have been supported more in their pursuit of a STEM degree believed it was important to pay it forward to the next generation of women.

Participants described efforts to pay it forward to students whose backgrounds did not reflect their own. David, a Hispanic male Ph.D. student, appreciated the opportunities to educate students at an all-girls school on their opportunities in engineering:

> My dad was the first generation to go to college as well, but when I go to the outreach events I'm aware of that. I make sure that I don't assume that students understand everything because I certainly didn't when I was high school or middle school. I also have younger sisters, and they're going through their bachelor's degrees right now, so I often think of them when I work these events. Especially, when it comes to things like scholarships and stuff like that because there's money out there, I feel.

Though he did not personally relate to the experience of the students at outreach events, he connected their experiences to his father and sisters.

Cara found her work with the nearby schools for the deaf and blind to be particularly rewarding precisely because their experiences did not seem to match her upbringing in a suburban, upper middle-class community:

> I've never done any activities at a school for the deaf or school for the blind prior to joining [my research group], and I think that actually did change the way I think about outreach. Generally, when you do these things, and I hate to say it, a lot of times the parents who are more involved in the school district are the ones that are seeking these activities. Somebody's daughter is in the school here, and they would love to hear from an engineer. I think these are the same wealthy, suburban high school kids that already have parents in these professions. But I think the activities we do through [my research group] are more focused on kids who may not have that background already.

For Cara, outreach was more fulfilling when the students were less likely to have prior exposure to engineering. Her outlook on outreach expanded to include students with backgrounds different from her own.

Other participants noted how, through their programs, their professors, and the initiatives they were involved in, they had the space and opportunity to take their passion for their field of research and share it with others. One participant, Elizabeth, made the observation that academia's mission was to share knowledge generated in the academy. She elaborated:

> In academia you take a really smart person and you put them in an area where they can share, and actually are mandated to share. The whole job is about sharing and building in a community of people. . . . A professor by definition [is] not a researcher who can escape and just be in their lab; an academic is someone who engages in their community and is civic engagement. Even researchers have to engage because when you publish on your research, you have to engage at least with your community and you have to share your knowledge and . . . a requirement of any research project is that you share knowledge and it's giving back.

Whether recruiting the next generation of women engineers or engaging in their community by sharing new knowledge, each of these participants saw how their activities could pay it forward to a variety of people. Or, in Matt's words, "I have a lot of those experiences and I feel like I can help other people have those experiences."

Discussion and Implications

Looking to a generation that is more likely to choose a career that will allow them to make a lasting impact on others *(Esfahani Smith & Aaker, 2013)*, our study examines how their motivations and meaning-making affect civic engagement among engineering graduate students. Our findings reveal that engineering graduate students are not only motivated to serve in different community engagement capacities, but, moreover, find meaning in their service. Some motivation for service likely arose from students' previous engagement in civic and community service activities as youth and undergraduate students. Participants discussed how they balanced community service and their academic and research obligations, and how their membership in a research program facilitated their work in these areas. These graduate students tied their service and outreach to a sense of personal fulfillment that improved their work in the classroom and lab. The professional benefits included advantages on grant applications and a sense of immediate gratification, a feeling not often found on a research team that may not see their work come to fruition for years. Both men and women in the study identified the civic engagement as a much-needed opportunity to encourage girls and young women to consider STEM education and careers. These results echoed O'Meara's *(2008b)* findings that community-engaged faculty more often reported intrinsic, rather than extrinsic, motivators for their engagement. Participants largely emphasized how engagement fulfilled a sense of personal identity and commitment to serve rather than focusing primarily on how such engagement would be rewarded externally.

Findings from this study reinforce the notion that engineering students' involvement in community-based activities fostered development of soft skills, such as communication skills *(Laursen et al., 2012; Wallen & Pandit, 2009)*. These skills benefit STEM students personally and professionally (e.g., enhanced confidence in public speaking and increased value to employers), including contributing to increased professional socialization *(Laursen et al., 2012)*. In addition, these skills are particularly valuable where there is a need to bridge the gap between engineering researchers and

the general public. Interaction with a variety of audiences creates opportunities for graduate students to serve the greater society by communicating research ideas beyond the scientific community. Furthermore, modeling civic engagement may motivate others to participate in similar activities, which is relevant given the significance of prior engagement in future decisions to participate in outreach and service.

Social exchange theory and Kolb's *(1984)* experiential learning theory served as frameworks for interpreting how the students' motivation and meaning-making in civic engagement shape their academic, personal, and professional trajectories. Our findings suggest it may be beneficial to incorporate civic engagement opportunities in graduate engineering programs heavily focused on research. Personal and professional benefits derived from civic engagement demonstrate that the decision between civic participation and STEM research need not be viewed as a zero-sum game.

STEM fields are typically less diverse in their racial, ethnic, and gender composition, and those who major in STEM report less community service involvement than peers in other fields *(Antonio et al., 2000; National Science Board, 2007)*; our study connects these pieces to inform how we may expand our understanding of engineering majors' involvement in civic engagement, and, proximally, increase STEM education to underserved communities. Given the success of mentoring in engaging future STEM students *(Ginorio & Grignon, 2000; Solórzano, 1993; Tsui, 2007)*, this study demonstrates the important role graduate students play in cultivating STEM interests among underrepresented populations.

Implications for Research and Practice

This study is of importance to researchers in higher education, psychology, and STEM fields, as well as policymakers who are grappling with the challenge of counseling, supporting, and understanding the impact of an increasingly constrained job market on a generation often viewed as "selfish" and "narcissistic" *(Twenge & Campbell, 2009)*. These participants present a contrasting view of engineering students in search of meaning, and ultimately purpose and happiness *(Baumeister, Vohs, Aaker, & Garbinsky, 2013; Levit & Licina, 2011)*. This research contributes to policy and practice, providing direction in our understanding of how graduate students in engineering fields can be drawn to civic engagement practices to address inequality in higher education and society writ large. Structured service opportunities, facilitated by programs such

as departmental research groups, may function to both socialize students into engineering fields and promote greater service commitments. Programs should recruit students with a prior record of service activities as well as those new to service, in addition to emphasizing the personal and professional benefits students accrue from service.

Limitations and Future Research

As a qualitative study, this project is not designed to generalize to all graduate STEM students, but findings may have transferability to other settings and populations beyond the research site. Additionally, the sample featured few engineers of color; future studies should seek ways to capture the experiences of underrepresented populations. Students who participated in this study evidenced significant prior engagement in community service activities, a characteristic that may limit the transferability of findings. Additional research should consider the role of prior service activities in shaping STEM graduate students' service priorities as well as exploring how to engage students without a record of service.

Conclusion

Researchers and policymakers have declared a national imperative for recruiting students into STEM fields. Many graduate students in STEM fields, including engineering, may prioritize academics and research, but this study suggests that these students may also seek to engage in intentional community service and civic engagement activities. Using social exchange theory and experiential learning theory, this study addressed how graduate engineering students from a research university described their service experiences and detailed how these experiences complemented, rather than detracted from, their academic work and future careers. Students carefully weighed the costs and benefits of service and reported that their communication skills improved as a result of service involvement. In addition, students felt called to pay forward the benefits they had received as young adults to future students and their communities. These findings may inform engineering graduate training and efforts to engage students in service and civic engagement activities.

References

Antonio, A. L., Astin, H. S., & Cress, C. M. (2000). Community service in higher education: A look at the nation's faculty. *Review of Higher Education, 23*(4), 373–398.

Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education, 73*(1), 94–122.

Austin, A. E., & McDaniels, M. (2006). Using doctoral education to prepare faculty to work within Boyer's four domains of scholarship. *New Directions for Institutional Research, 129*, 51–65.

Baumeister, R. F., Vohs, K. D., Aaker, J. L., & Garbinsky, E. N. (2013). Some key differences between a happy life and a meaningful life. *Journal of Positive Psychology, 8*(6), 505–516.

Boyer, E. L. (1996). The scholarship of engagement. *Bulletin of the American Academy of Arts and Sciences, 49*(7), 18–33.

Bringle, R. G., & Hatcher, J. A. (2002). Campus–community partnerships: The terms of engagement. *Journal of Social Issues, 58*(3), 503–516.

Butin, D. (2006). The limits of service-learning in higher education. *The Review of Higher Education, 29*(4), 473–498.

Carnegie Classification of Institutions of Higher Education (n.d.). *About Carnegie Classification*. Retrieved from http://carnegieclassifications.iu.edu/

Center for the Integration of Research, Teaching, and Learning. (2016). *About CIRTL.* Retrieved from https://www.cirtl.net/p/about-us-cirtl

Chang, Y. J., Wang, T. Y., Chen, S. F., & Liao, R. H. (2011). Student engineers as agents of change: Combining social inclusion in the professional development of electrical and computer engineering students. *Systemic Practice and Action Research, 24*(3), 237–245.

Cherwitz, R., & Sievers, J. (2003). Ethical commitments, professional visions, and intellectual choices: Students call for changes in graduate education. *Communicator, 36*(3), 21–22.

Cherwitz, R. A., & Sullivan, C. A. (2002). Intellectual entrepreneurship: A vision for graduate education. *Change: The Magazine of Higher Learning, 34*(6), 22–27.

Coyle, E. J., Jamieson, L. H., & Oakes, W. C. (2005). EPICS: Engineering Projects in Community Service. *International Journal of Engineering Education, 21*(1), 139–150.

Coyle, E. J., Jamieson, L. H., & Oakes, W. C. (2006). 2005 Bernard M. Gordon Prize Lecture: Integrating engineering education and community service: Themes for the future of engineering education. *Journal of Engineering Education, 95*(1), 7–11.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Los Angeles, CA: Sage.

Eagen, M. K., Sharkness, J., Hurtado, S., Mosqueda, C. M., & Chang, M. J. (2010). Engaging undergraduates in science research: Not just about faculty willingness. *Research in Higher Education, 52*(2) 151–177.

Emerson, R. M. (1981). Social exchange theory. In M. Rosenberg & R. H. Turner (Eds.), *Social psychology: Sociological perspectives* (pp. 30–65). New York, NY: Basic Books.

Esfahani Smith, E., & Aaker, J. L. (2013, November 30). Millennial searchers. *The New York Times.* Retrieved from http://www.nytimes.com/2013/12/01/opinion/sunday/millennial-searchers.html

Fink, M. L. (2009). Preparing future teachers using a SENCER approach to positively affect dispositions toward science. *Science Education & Civic Engagement: An International Journal, 2*(1), 14–21.

Fisher, D. R., Bagiati, A., & Sarma, S. (2017). Developing professional skills in undergraduate engineering students through cocurricular involvement. *Journal of Student Affairs Research and Practice, 54*(3), 286–302.

Franz, N. K. (2013). Preventing graduate student heroic suicide in community-based research: A tale of two committees. *Journal of Public Scholarship in Higher Education, 3*(2013), 111–127.

Fredeen, D. A. (2012). Weaving a tapestry of change: Implementing SENCER on campus. In R. D. Sheardy & W. D. Burns (Eds.), *Science education and civic engagement: The next level* (pp. 31–54). Washington, DC: ACS Publications.

Gardner, S. K. (2007). "I heard it through the grapevine": Doctoral student socialization in chemistry and history. *Higher Education, 54*(5), 723–740.

Gardner, S. K. (2010). Faculty perspectives on doctoral student socialization in five disciplines. *International Journal of Doctoral Studies, 5*(2010), 39–53.

Gergen, C. (2012, April 17). The benefits of civic engagement for tomorrow's leaders. *The White House Blog.* Retrieved from https://www.whitehouse.gov/blog/2012/04/17/benefits-civic-engagement-tomorrows-leaders

Ginorio, A. B., & Grignon, J. (2000). The transition to and from high school of ethnic minority students. In G. Campbell, R. Denes, & C. Morrison (Eds.), *Access denied: Race, ethnicity, and the scientific enterprise* (pp. 151–173). New York, NY: Oxford University Press.

Goggins, J. (2012). Engineering in communities: Learning by doing. *Campus-Wide Information Systems, 29*(4), 238–250.

Golde, C. M., & Dore, T. M. (2001). *At cross purposes: What the experiences of doctoral students reveal about doctoral education*. Philadelphia, PA: The Pew Charitable Trusts.

Greenwood, P. (2007). Helping small businesses survive the skill shortage: An Australian perspective. *IDEAS, 14*(November), 17–25.

Griffin, K. A. (2008). *Can reaching back push you forward?: A mixed methods exploration of Black faculty and their developmental relationships with students* (Unpublished doctoral dissertation). University of California, Los Angeles, CA.

Groenewald, T. (2004). A phenomenological research design illustrated. *International Journal of Qualitative Methods, 3*(1), 42–55.

Heller, R. S., Beil, C., Dam, K., & Haerum, B. (2010). Student and faculty perceptions of engagement in engineering. *Journal of Engineering Education, 99*(3), 253–261.

Homans, G. C. (1958). Social behavior as exchange. *American Journal of Sociology, 63*(6), 597–606.

Johnson, W. B., Rose, G., & Schlosser, L. (2007). Student–faculty mentoring: Theoretical and methodological issues. In T. D. Allen & L. Eby (Eds.), *Blackwell handbook of mentoring: A multiple perspectives approach* (pp. 49–69). London, England: Blackwell.

Kolb, D. A. (1981). Learning styles and disciplinary differences. In A. W. Chickering & Associates (Eds.), *The modern American college: Responding to the new realities of diverse students and a changing society* (pp. 232–255). San Francisco, CA: Jossey-Bass.

Kolb, D. A. (1984). *Experiential learning: Experience as a source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education, 4*(2), 193–212.

Kvale, S. (1996). *Interviews: An introduction to qualitative research interviewing*. Thousand Oaks, CA: Sage.

Latimore, J. A., Dreelin, E. A., & Burroughs, J. P. (2014). Outreach and engagement education for graduate students in natural resources: Developing a course to enrich a graduate outreach requirement. *Journal of Higher Education Outreach and Engagement, 18*(3), 129–154.

Laursen, S. L., Thiry, H., & Liston, C. S. (2012). The impact of a university-based school science outreach program on graduate student participants' career paths and professional socialization. *Journal of Higher Education Outreach and Engagement, 16*(2), 47–78.

Lawler, E. J., & Thye, S. R. (1999). Bringing emotions into social exchange theory. *Annual Review of Sociology, 25*, 217–244.

Levit, A., & Licina, S. (2011). *How the recession shaped millennial and hiring manager attitudes about millennials' future careers*. Retrieved from http://www.careeradvisoryboard.org/content/dam/dvu/www_careeradvisoryboard_org/Future-of-Millennial-Careers-Report.pdf

Levkoe, C. Z., Brail, S., & Daniere, A. (2014). Engaged pedagogy and transformative learning in graduate education: A service-learning case study. *The Canadian Journal of Higher Education, 44*(3), 68–85.

Matthews, P. H., Karls, A. C., Doberneck, D. M., & Springer, N. C. (2015). Portfolio and certification programs in community engagement as professional development for graduate students: Lessons learned from two land-grant universities. *Journal of Higher Education Outreach and Engagement, 19*(1), 157–183.

May, D. (2017). Student perceived value of intensive experiential learning. *International Journal for Service Learning in Engineering, Humanitarian Engineering and Social Entrepreneurship, 12*(1), 1–12.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, CA: Sage.

Nasr, K. J. (2014). Towards a converged and global set of competencies for graduates of engineering programs in a globalization-governed world. *IDEAS, 18*(March), 15–32.

National Science Board. (2007). *A national action plan for addressing the critical needs of the U.S. science, technology, engineering, and mathematics education system*. Arlington, VA: National Science Foundation.

National Survey of Student Engagement. (2012). *Promoting student learning and institutional improvement: Lessons from NSSE at 13*. Bloomington, IN: Indiana University Center for Postsecondary Research.

O'Meara, K. (2008a). Graduate education and community engagement. In C. L. Colbeck, K. O'Meara, & A. E. Austin (Eds.), *Educating integrated professionals: Theory and practice on preparation for the professoriate* (New Directions for Teaching and Learning, No. 113, pp. 27–42). San Francisco, CA: Jossey-Bass.

O'Meara, K. (2008b). Motivation for faculty community engagement: Learning from exemplars. *Journal of Higher Education Outreach and Engagement, 12*(1), 7–29.

O'Meara, K. (2011). Rewarding multiple forms of scholarship: Promotion and tenure. In H. E. Fitzgerald, C. Burack, & S. D. Seifer (Eds.), *Handbook of engaged scholarship: Contemporary landscapes, future directions: Vol. 1. Institutional change* (pp. 271–294). East Lansing, MI: Michigan State University Press.

O'Meara, K., & Jaeger, A. J. (2006). Preparing future faculty for community engagement: Barriers, facilitators, models, and recommendations. *Journal of Higher Education Outreach and Engagement, 11*(4), 3–25.

Reddick, R. J., Griffin, K. A., Cherwitz, R. A., Cérda-Pražák, A. A., & Bunch, N. (2012). What you get when you give: How graduate students benefit from serving as mentors. *Journal of Faculty Development, 26*(1), 37–49.

Ritchie, J., & Ormston, R. (2014). The applications of qualitative methods to social research. In J. Ritchie, J. Lewis, C. McNaughton Nichols, & R. Ormston (Eds.), *Qualitative research practice: A guide for social science students and researchers* (2nd ed., pp. 27–46). Los Angeles, CA: Sage.

Ritchie, M., & Tate, J. F. (2016). Storm impacts research: Using SENCER-model courses to address policy. *Science Education & Civic Engagement: An International Journal 8*(1), 22–29.

Science Education for New Civic Engagements and Responsibilities. (2016). *Our mission.* Retrieved from http://sencer.net/our-mission/

Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (3rd ed.). New York, NY: Teachers College Press.

Sergent, M. T., & Sedlacek, W. E. (1990). Volunteer motivations across student organizations: A test of person–environment fit theory. *Journal of College Student Development, 31*(3), 255–261.

Smith, K. A., Clarke Douglas, T., & Cox, M. F. (2009). Supportive teaching and learning strategies in STEM education. *New Directions for Teaching & Learning, 117*, 19–32.

Solórzano, D. G. (1993). *The road to the doctorate for California's Chicanas and Chicanos: A study of Ford Foundation minority fellows.* Berkeley, CA: The Regents of the University of California. Retrieved from ERIC database. (ED 374-941)

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques.* Newbury Park, CA: Sage.

Sullivan, W. M. (2005). *Work and integrity: The crisis and promise of professionalism in America.* San Francisco, CA: Jossey-Bass.

Tsui, L. (2007). Effective strategies to increase diversity in STEM fields: A review of the research literature. *Journal of Negro Education, 76*(4), 555–581.

Twenge, J. M., & Campbell, W. K. (2009). *The narcissism epidemic: Living in the age of entitlement.* New York, NY: Simon & Schuster.

van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy.* Albany, NY: State University of New York Press.

Verner, I. M., & Ahlgren, D. J. (2004). Robot contest as a laboratory for experiential engineering education. *ACM Journal on Educational Resources in Computing, 4*(2), 1–15.

Wallen, M., & Pandit, A. (2009). Encouraging undergraduate engineering students towards civic engagement. *European Journal of Engineering Education, 34*(2), 141–148.

Welman, J. C., & Kruger, S. J. (1999). *Research methodology for the business and administrative sciences.* Johannesburg, South Africa: International Thompson.

White House Office of Science and Technology Policy. (2013, April 10). *Preparing a 21st century workforce: Science, technology, engineering, and mathematics (STEM) education in the 2014 budget.* Retrieved from https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/2014_R&Dbudget_STEM.pdf

Zlotkowski, E. (2007). The case for service learning. In L. McIlrath & I. MacLabhrainn (Eds.)., *Higher education and civic engagement: International perspectives* (pp. 37–52). Aldershot, UK: Ashgate.

About the Authors

Richard J. Reddick is an associate professor in educational leadership and policy at the University of Texas at Austin. His research focuses on the experiences of faculty of color at predominantly White institutions; mentoring between faculty and Black students; and work–life balance in academia. He earned his Ed.D. from the Harvard Graduate School of Education.

Laura E. Struve is a postdoctoral fellow at the Faculty Innovation Center at the University of Texas at Austin. Her research focuses on issues related to equity and inclusion in higher education, career pathways in higher education, and intersectional aspects of identity development in graduate students. She earned her Ph.D. from the University of Texas at Austin.

Jeffrey R. Mayo is a senior academic program coordinator in the School of Undergraduate Studies at the University of Texas at Austin. His work and research focus on transfer and community college student success, higher education policy, and online learning. He earned his Ph.D. in higher education leadership and policy from UT Austin.

Ryan A. Miller is assistant professor of educational leadership (higher education) at the University of North Carolina at Charlotte. His research agenda focuses on college student development and the conditions for creating inclusive campus

cultures in higher education. He received his Ph.D. from the University of Texas at Austin.

Jennifer L. Wang is the director of international advancement, Asia in the University Development Office at the University of Texas at Austin. Her research focuses on the leadership of Asian American university administrators. She earned her M.Ed. in Higher Education Leadership at UT Austin.