The benefits of ethnographic research in exploring new intervention in STEM higher education programs

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The benefits of ethnographic research
for exploring new STEM higher education programs

Abstract

This study describes an initial cycle of inquiry within a multi-year research initiative for a new Naval Workforce Program (NWP) designed to increase the number of underrepresented individuals (veterans and minorities) in STEM professional contexts, particularly within the context of naval engineering and design.

The research practices within the NWP follow a logic of inquiry that is grounded in Interactional Ethnography (IE) and is based on interactions and collaborative work among all participating stakeholders, including program coordinators, naval-base professionals, university researchers, and all student participants. These lines of inquiry are shaped by observed stakeholder experiences, perspectives, and attitudes that are systematically documented via recorded exchanges, discussions, individual and collaborative work products, and field notes. We argue that such ethnographic research is culturally responsive to the underrepresented students, with particular interest in increasing the potential for meeting the goals of increasing the number of veteran individuals in STEM professional contexts. Our telling case focuses on a discovery that emerged from discussion with a group of participants who are veterans; several members comment on how perceptions about public views of veterans can be a hindrance in pursuing civil (non-military, non-combat) careers in STEM. Our exploration of this interaction doubly serves as an illustration of the inquiry process and insight derived from IE in action.

Introduction

In recent years, qualitative inquiry has played an increasingly prominent role in higher education research, as educators and scholars strive to understand the complexities of learning and instruction within university and professional settings (Pasque& Lechuga, 2017; Trowler, 2014). Researching such learning communities involves a systematic exploration of many contextual aspects, including "the culture of the institution, the administrative hierarchy, students, faculty, and external constituencies" (Pasque & Lechuga, 2017, p. 2).

The recent surge in ethnographic or participant-centered, qualitative research in higher education aligns with an increased awareness that classrooms, programs, lectures, work sessions and the like all operate within a system that is multilayered and often hierarchical (Bryk, Sebring, Allensworth, Easton, & Luppescu, 2010). As such, final scores or reflections may hint at the components, activities, and resources most useful to, or constraining the realization of programmatic goals, yet such instruments are not designed to provide researchers, developers and other stakeholders a representation of what was accomplished and which resources were taken up by participants for what means and conditions. Such post hoc instruments also would not be enough for making visible what was accomplished during an innovative program and what might be replicable for other potential sites that may or may not operate within a similar system. We present a complete line of inquiry to illustrate how a particular form of ethnography called Interactional Ethnography (IE, Green, Skukauskaite & Baker, 2012) can provide researchers, program developers, and all other stake holders (participants, program officers, policy makers, etc.) a way of *seeing* the experiences and perspectives of program participants that allows us greater depth in understanding program benefits and constraints that lead to stronger programs, better resources, and increased equity in STEM. Our endeavor is supported by other researchers in engineering education who continue to report woefully limited understanding about veterans' college transition experiences and perspectives and the particular resources and support that support such transitions (e.g., Lim et al., 2016).

Ethnography as an epistemology. Interactional Ethnography (referred hereon as IE) served as the epistemological guide during our exploration of a new higher education program for community college students created through the collaborative efforts of a four –year Research University (RU) and a nearby Naval Base (NB). What actually happened within this STEM summer experience program? What was accomplished daily by whom, under what circumstances and for what purposes? What surprises or confusions occurred among participants, program developers, and researchers, and what can we learn from these discoveries? Such questions cannot be adequately addressed with a survey score, project artifacts or performances; we must explore from the "ground" (i.e., the program as it is experienced daily by the student participants) with a constant (recursive) effort to capture the participants' viewpoints to address such questions. This form of inquiry is necessarily derived from an ethnographic perspective that privileges the participant as the *cultural guide* (an inside member of the targeted learning community) to the researchers who are striving to know more about participant experiences and attitudes.

Recursive frame of inquiry. Ethnography is the process of reconstructing and representing the insiders' work life (experiences, perspectives, and attitudes) within a particular community,

setting, and culture. In a sense, the findings produced from an ethnographer comprise a type of primer for others to learn what program participation was like for whom and when different or conflicting expectations, perspectives, beliefs or attitudes arise; we strive to learn "what difference these differences make" (Gergen & Gergen, 2014, p. 217). And since the focus is on the participants as cultural guides, much of our guided inquiry hinges on the actions and responses of our participants and the resources that they take up or leave untouched. Such actions inspire lines of inquiry that guide our reconstruction process; thus, there is no set plan of action beyond this recursive framework (i.e., what is being accomplished, by whom, for what purposes, etc.). Within this recursive litany of inquiry, we engaged in the iterative process of unpacking unexpected events or surprising discoveries, which in turn support our efforts in representing the experiences and perspectives of our participants and thus making visible key constructs and qualities of a successful program for all participants, and particularly for veterans, women and cultural minorities.

The methods used by Interactional Ethnographers are designed to generate "thick descriptions", which move beyond a simple log of behaviors and actions to include intentionality of such (Geertz, 1973). From these descriptions, researchers can identify unexpected, conflicting or confusing phenomena called frame, or ideological clashes that emerge as "rich points" (e.g., Agar, 1994, p.26). Rich points do not emerge linearly in that clashes occur at the intersections of observation and hinge on the overlap (or lack thereof) of backgrounds, experiences, expertise, and ideologies among the researchers, program developers, site facilitators and the participants. With so many diverse and complex elements among all stakeholders, it would be impossible to predict and prepare for such clashes. Thus, we view ethnography as epistemology that supports a nonlinear, iterative, and recursive logic of inquiry (Green et al., 2012; Wolcott, 1999). These qualities are catalyzed by an abductive approach (i.e., considering plausible explanations for a given, unexpected phenomenon) for gaining a deeper understanding about the benefits and potential constraints of a new program.

Iterative abductive reasoning. Within the recursive frame (consistent, long-standing inquiry) of building thick descriptions of participants' lived experiences within the NWP, we engaged in an empirical process of addressing emerging, unexpected phenomena; that is, we engaged in the process of *abducing* as originally described by philosopher and logician Charles Peirce (1958). Within an ethnographic framework, abducing involves the consideration of plausible explanations for the unexpected phenomenon, followed by an exploration and testing of most plausible explanations, including the participants themselves as co-researchers who are cultural guides in making visible their life-work experiences within a learning community.

In our study, we took up moments during captured interactions that were confusing or surprising to us and considered multiple explanations before deciding on one or more explanations to test. One of the most common ways of testing our hunches was to revisit our participants (cultural guides) for follow-up conversations. Such conversations helped in confirming or dismissing our previous thinking, leading to new inferences and subsequent lines of investigation. Thus, our lines of inquiry consistently involved the input of our participants who, as previously mentioned, were our cultural guides during the initial iteration of our study. We argue that such research methodology is culturally responsive to the voices of our participants, a significant portion of

whom were minorities and/or veterans and who provide insight about various programmatic goals, resources and activities and their value for sustaining STEM interest and career pursuits.

Methodology

Context

The Naval Workforce Program[1] (hereon referred as NWP) was realized upon a signed three-year agreement between a research university (RU) and a nearby Naval Base (NB) to develop a STEM summer experience program for community college students in California. Both institutions agreed to support the development of a program that presented engineering design challenges for participating students to tackle within a team context. These challenges were designed to engage and motivate students, while supporting the needs of the NB and while being manageable within the set duration of the program, which lasted eight weeks. The desired outcomes of this signed agreement are threefold: (a) an increased number of veterans and underrepresented community college students pursuing science, technology, engineering, and mathematics (STEM) within higher education, (b) a stronger pipeline for local undergraduates in pursuit of Navy civilian careers (i.e., non-military or non-combat related work and planning) in science and engineering, and (c) a greater understanding about what constitutes STEM thinking, being and doing within a naval engineering context. Included in these desired outcomes is our interest in recruiting and successfully supporting participating veterans, who have been purported to be an untapped resource of expertise and knowledge highly relevant to engineering (Crawford & Burke, 2016; Jovanovic et al., 2016). We postulated that our veteran participants would have an insider's advantage compared to non-veteran participants due to the naval context, and that this unique knowledge base would provide a more balanced distribution of knowledge and expertise across our teams.

Actors

The epistemic principles of IE highlight the need for researchers to explore potential programmatic influences beyond the immediate circle of participants and their supporting mentors. Program designers, naval base leaders, engineering educators and even the researchers themselves play a role in shaping experiences and resources for participants. As such, our logic of inquiry includes such multilayered actors in order to gain a full picture of a program in progress (Spradley, 1980/2016). Each layer of actors is respectively described below.

NWP participants. Ken, the leader of the engineering sector within the NB, facilitated the recruitment and final appointment of five lead engineers to serve as project mentors for the program. These project mentors selected ten community college students from a shortlist of 20 candidates provided by two members of the RU team (lead principal investigator and graduate student researcher) who conducted 34 interviews from an original pool of 58 applicants. Original applicants represented a range of individual differences: 26% female, 55% underrepresented ethnic minorities; 57% first generation; 27% veterans; 62% low-income; 5% students with

disabilities[2]. The final selection of ten from this diverse pool echoed such diversity: two females, five minorities, 7 first-generation, 6 veterans, 7 low-income, and 1 with disabilities. In addition to the 10 community-college students, each of the five NB project mentors hired an undergraduate student applicant attending a four-year institution (including the RU) to serve as a project intern for their respective challenge group; this hiring process did not involve the RU as the interns were directly hired by the NB. The five hired interns were all male with one being a veteran; other cultural demographics were not accessible due to the separate hiring process.

The five project-challenge groups were organized in groups of three internal members—two community college students and one undergraduate student. Each triad also received participative guidance from the NB project leader who checked in with their team regularly (at least several times per week) throughout the course of the program. Further a graduate student selected by the RU project leader (coauthor) met with the internal team on a weekly basis to offer additional support and guidance. Each week, participant groups worked on their respective engineering design challenge (as introduced by the NB project mentors) from Monday through Thursday, and visited the RU for consulting with the graduate student mentors and attending an entrepreneurship and innovation course on Fridays during the eight-week summer program. The course was designed to support 'innovative thinking' (i.e., ability to think outside the box and create new ideas) that would in turn support the collaborative teamwork during the week at the NB.

Compared with their peers, significantly fewer veterans under the age of 30 have completed an associate's degree or higher, arguably in part due to the military occupations in lieu of college experiences. While this gap in college degrees decreases between veterans and non-veterans of older cohorts, the observed spike in unemployment for veterans underscores the importance of providing programs and services that support a successful transition to post-military careers (Dayton, 2016; Rothwell, 2014). Exploration throughout the course of the NWP may shed more light on this observed finding, clarifying if other factors, besides the obvious choice differences in post-high school directions, may contribute to potential opportunity gaps for veterans.

Project mentors. Five engineers of five different divisions within the NB engineering sector were selected by Ken to serve as project mentors for the NWP's first summer iteration. All five project mentors were male and all but one identified as White (one identified as Latino). Each of these mentors identified a project challenge that was an actual problem within their division and deemed appropriate for a novice group of college students to solve within an eight-week period. For example, one of these challenges was to design a new ladder strong enough for moving heavy equipment on and off an amphibious vessel (i.e., an ocean boat-like vessel that can also be driven on land), but also light enough for efficient removal.

Graduate student mentors. The principal investigator from the RU recruited and selected five graduate students (three males, two females) to serve as graduate student mentors for each of the five design challenge teams. These graduate students were relatively more advanced in their knowledge in mechanical or electrical engineering compared with the participants, and thus served as 'cultural guides' for the team, answering theoretical, process and procedure-oriented

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[2] Specific disabilities were not specified.

questions to support thinking about and solutions for their team's particular challenge. Graduate student mentors met with their respective team on a weekly basis, during the Friday RU sessions.

Program leaders/educators. The leadership guiding the development and implementation of NWP includes two researchers who represent the RU and are tasked to facilitate program implementation and research efforts. The lead principal investigator (coauthor), is a lead researcher within an engineering sciences department, while the co-principal investigator (first author) is a literacy scholar and faculty member within the education department. In addition to the PI and co-PI, Ken, director of the NB's engineering sector, is the official lead for all program activities that occur on the base. During the summer, communication between the leaders of both sites (mainly in the form of email messages) focused on program logistics (scheduling, gaining clearance, etc.), general check-ins and updates on the progress of participants, as well as the overall success of the program. Two professors within the engineering sciences of the RU and a professor in English education from another RU provided consultation for the program leaders and researchers. These individuals are considered experts in their respective fields and helped to provide additional insight into or alternative explanations for unexpected observations or phenomena. These educators also helped to ensure the inclusion of educational perspectives across disciplines.

Ethnographic researchers. Three researchers from the RU included the program co-investigator, graduate student research and program coordinator (second author), and a senior external ethnographer. While the first two researchers worked daily to observe, record and inquire about participant practices, processes and perspectives, the third external ethnographer served as a guiding anchor during the phase of reconstructing the experiences and artifacts gathered since the inception of NWP.

In *doing* ethnography, multiple researchers with varying roles and background knowledge are necessary for helping one another maintain a focus on the emic perspective, that is, multiple colleagues support any inadvertent bias that would hinder the ability to adequately represent insiders' perspectives. For example, the lead researcher of this present study (first author) is a former classroom teacher and thus maintained this awareness during observations of student interactions; several times the researcher had to resist the temptation to interject suggestions during discussions as a form of instructional support. The co-researcher (second author) often provided a glimpse of insider's perspectives due to the fact that she is a veteran and thus had some understanding about military-related language and practice that participants experienced.

External evaluator. An external evaluator joined the team, as is generally accepted practice for all federally funded workforce development projects, to conduct survey items and interviews at the beginning and following the eight-week program. This evaluator had a minimal role in shaping the project itself and thus served as an external assessor of the efficacy of this program.

Figure 1 below illustrates the organizational structure of all described actors. Such a mapping of relationships is common practice in IE research, providing transparency in reporting the ways in which different stakeholders relate to a given initiative or program.

Figure 1. Organizational Mapping.
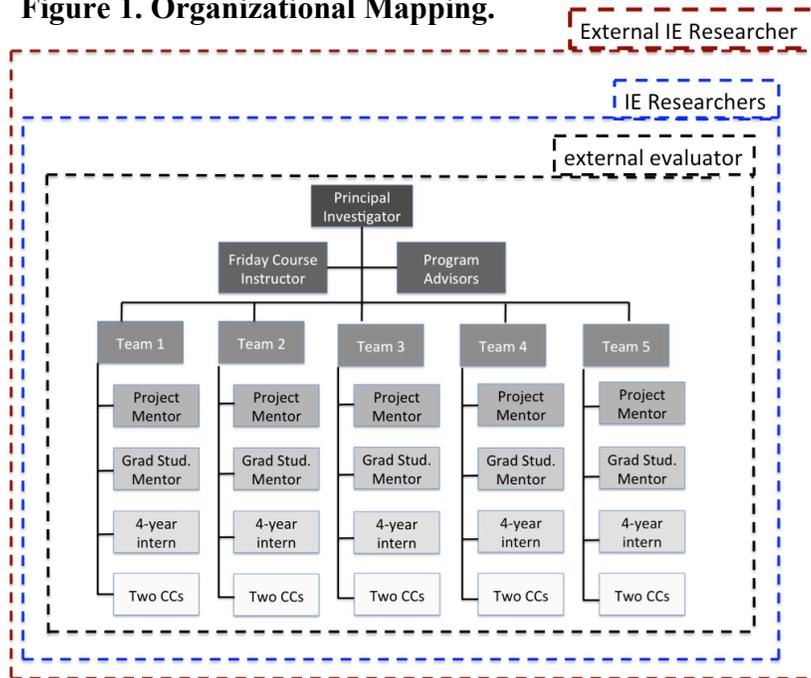

Data Sources

In ethnography, data are created, not collected. Specifically, activities, events, products, relevant objects, and interviews of such are recorded in the forms of audio, video and image. These records form an archive, which is organized by date and summary log. This archive serves as a data source for systematic analyses sparked by the discoveries (rich points and frame clashes). As such, data sources are explored with the cultural guidance of the actors described above.

We recorded the interactions, presentations, and creations of the five challenge teams across the eight-week period. This data collection process during this period resulted in the following records: 8 hours and 33 minutes of audio data; 31 hours and 27 minutes of video footage; 456 images; 35 artifacts produced from student activities, presentations, discussions, interviews, notebooks, and course materials. These records, 625 in total, were available for systematic analyses of professional opportunities for participants. We captured the long-term project of presenting themselves and their work in varying engineering career-related scenarios. In addition to learning about the participants' perspectives and uptake of such various speaking opportunities, we were curious how such diverse interactions could support the growth of participants' analytical thinking and identity development in being an engineer within this naval context.

Analytic Framework (Abductive reasoning in action)

One particular discovery, a rich point, emerged during the first week of the program, while engaging in a conversation with a group of participants who were veterans. Figure 2 below shows a cascade of event maps to illustrate this rich point moment within the context of the summer program. IE researchers construct event maps to make visible for themselves and others the boundaries of phenomena under study (Castanheira, Crawford, Dixon & Green, 2001). The reconstruction of this comprehensive map offers a bird's eye view of the summer program according to the general structures set prior to implementation.

Figure 2. Event maps, program level (zoomed out) and specific event (zoomed in).
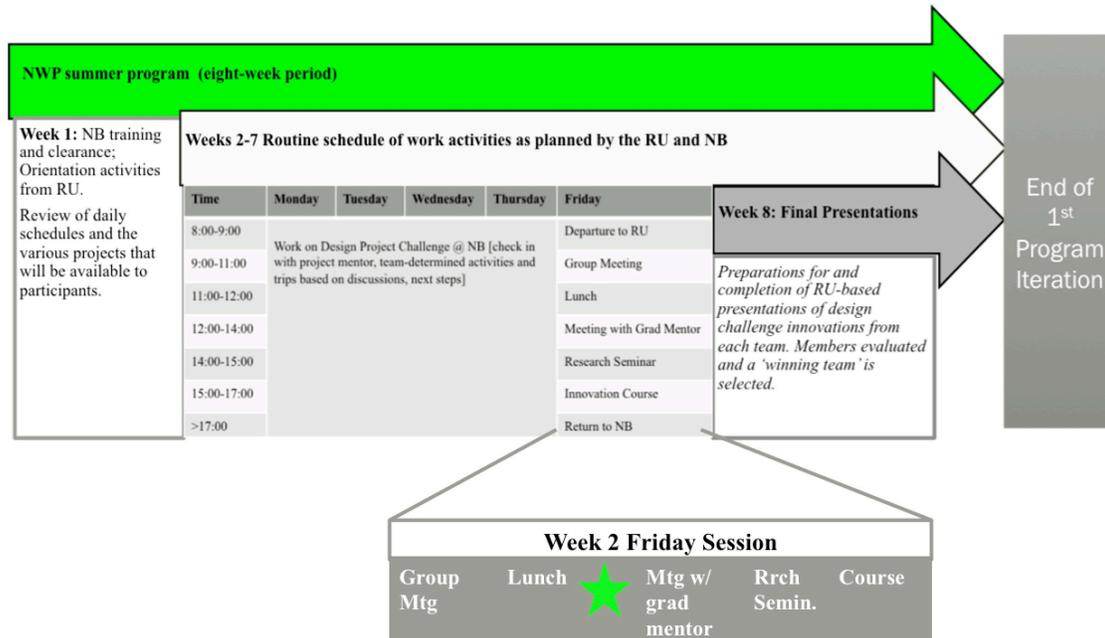
The construction of this cascading event maps was accomplished through a systematic process that began with working from the last major event/product (the final presentations of the summer program) and mapping backwards through to the first event/product (the initial orientation and training at NB). From this comprehensive, *zoomed out* picture, specific events and points in time are identified in order to clarify what researchers *zoomed in* for closer analysis. For this particular iteration, we zoomed in on a comment from one of the veteran participants during a recorded group discussion (event indicated by the star in Figure 3 above). One of the members during this discussion shared a surprising perspective for the researchers (female) and a veteran participant who was female; the other participants were males. We transcribed the audio-recorded interaction according to individual message units (i.e., utterances produced as they are cognitively constructed by the individual, a single thought or pause at a time) is used in the microethnographic approach as described by sociolinguistic scholar Bloome and colleagues (2004). This framing of talk in the form of message units, without punctuation that is traditionally used in writing and composition is, according to theorists of this approach, a way to present talk in its authentic form, and thus bringing the reading audience closer to the event as it happened.

Preliminary Findings (Building Connections)

Below is the transcript of the recorded interaction related to the rich point. Participants included in this discussion involved the two IE researchers (R1 and R2) and four participants who are veterans, one of whom is a female. The rich point emerged from comments made by Anna and Neal, who is also a minority. Key utterances are bolded for greater accessibility.

R1:   *We're just starting off with a general question*
        just tell us about
        first of all
        what factors do you think affect veteran and minority students'
        participation in academic success in STEM
        that's a loaded question
        but you can take parts of that

Anna: *it's a huge challenge for people*
        when they get out
        it's a bit tough transitioning to civilian life
        but I think it's just a small hurdle
        once you're past that you're past that
        and you're looking at bigger greater things

R2:   *we want to understand how that transition*
        has helped you in particular to your background
        whether you're a woman
        minority
        or um
        academics was strong for you
        we're trying to understand your perspective
        on what is helping you
        or hindering you
        as you pursue or finish your
        STEM degree

Neal: *um*
        some things sort of er
        I definitely have been more focused
        in pursuing my degree in the sense that
        I know exactly what I want
        I sort of see
        I sort of have a goal planned out
        so I definitely will go past my bachelors
        and go to grad school
        and transitions like that
        I guess one of the hindrances I have had
        um
        I wouldn't say necessarily say

I guess as a minority
but I guess more as a veteran
is um
sometimes
um
you can please interrupt me if anyone thinks
but um
I've had like
people sort of have this
it's like a two-way street of being a veteran
they'll go
oh you're a veteran
like congrat—
well done and all that
like I have this respect for you
or
you're a veteran
what's wrong with you
so um
I kinda don't want
you know
I don't tell people that I am in sense
until I'm sort of sure how they will react

R1:   *Could you share more about*
       what you mean by
       something being wrong—

Neal: **um there is sort of the assumption**
       like something either physically or mentally
       or something wrong with you
       um a lot of it is
       and if they don't see it's something physical
       I'm gonna take it easy around you
       'cause I think he might snap at a moment's notice

R1:   *oh I see*

Neal: *you know*
       there's just the whole
       like I dunno
       they feel
       the need to
       sorta
       emasculate themselves around you
       for the men

um
that's sort of the major hindrance I've seen

The other two male veterans followed with brief verbal confirmations (*yeah, I agree; I feel that a lot*) of Neal's perspective that veterans are often stereotypically viewed as physically or mentally unstable while the researchers and Anna expressed surprise about this view. Anna's comment (bolded above) in fact seems to contradict Neal's sentiment, that the transition is not so difficult.

During a debriefing conversation among the RU team (the two IE researchers, lead investigator and external evaluator), the lead investigator offered her observation of how relatively barren veteran outreach centers were on the community college campuses that she visited during the recruitment phase of our project. While she remarked on the numerous students (at least 20 students milling about, chatting, reading, etc.) in MESA centers, the veteran centers by contrast would consistently have perhaps one or two students perusing pamphlets or chatting with staff.

Discussion

During the 1980s, educational literacy researchers began to reframe research practices; rather than researching literacy as a discrete task or product (e.g., score on a pre/post test), these scholars began to pursue ethnographic explorations in order to capture the historical and sociocultural nature of literacy and the complex layers of actors that shape and determine what counts as literate practice for whom (Grenfell, Bloome, Hardy, Pahl, Rowsell & Street, 2013). Since then, ethnographic research has been making its way across disciplines, with a recent surge in interest among STEM higher education educators and researchers. We believe that this increased interest is spurred by the desire to dig beneath the surface of what makes a successful program for underrepresented individuals, and, for this particular line of study, we have focused on veterans. Our study is an illustration of how ethnographic research, specifically IE, can bring new insight into the affordances and hindrances for veterans who, with their experiential knowledge, have much to offer in STEM career contexts.

The rich point from Neal's comment presented earlier sheds light on an alternative plausible explanation, at least for male veterans, for the aforementioned opportunity gap, in completing degrees in higher education (Dayton, 2016; Rothwell, 2014). In a review of literature about veterans' transitions to college campuses, the majority of findings and suggested policies focus on the need for colleges and universities to employ all available resources, particularly mental health-related support, for directly supporting veterans, who have been noted to express feelings of alienation and exclusion on campus (e.g., DiRamio, Ackerman & Mitchell, 2008). A large-scale study by Elliott, Gonzales and Larsen (2011) highlighted a veteran's comment about the insensitivity of one professor who claimed that U.S. troops were "terrorists," and the overall unwelcome feeling on campus. While the authors suggest that faculty should be made aware of such issues, they also suggest that "it would be impossible, and probably not desirable, to censor faculty to the point where there is no chance of offending a veteran. Therefore, support services outside of the classroom are needed where student veterans can express their frustration and have their outrage acknowledged" (p. 289). Neal's comment that was supported by the other male veterans suggests that while providing a space for venting frustrations may certainly be helpful, social intervention programs involving the broader faculty and student populations may be

needed to help ameliorate biased attitudes towards veteran students. This sentiment is moderately supported by a recent study by Main et al. (2016) who mentioned anecdotally from their interviews of 21 veterans that some respondents (the number was not reported) chose to not disclose their status as a veteran, preferring "to 'hide' their veteran status, or at least relegate it to secondary status, as compared to their other statuses (e.g., parent, engineering major, etc.)" (p.8). While more exploration is needed to confirm and clarify this potential bias, implications for engineering education may include sensitivity training among educators and administrators similar to established diversity and equity training programs for issues related to race and gender. Moreover, the aforementioned postulate of veteran participants potentially benefitting from the naval context (i.e., acting as cultural guides for non-veteran participants) seems at the least questionable; is there is a social desire to hide one's status as a veteran, then such knowledge may remain untapped.

Further exploration is needed to clarify (a) the prominence of this perceived stereotype among veterans, (b) how this perceived hindrance may affect veteran recruitment and engagement in pursuing higher education degrees in STEM. Hence, when doing ethnography, researchers confront frame clashes and rich points that in turn lead to new questions about the phenomenon under study. Such iterative questioning is the catalyst of abductive reasoning and for gaining a deep understanding of what is happening to whom, with whom and for what purposes. Further analyses and exploration will unpack these initial discoveries about veteran perceptions, which we believe warrant serious consideration when recruiting and designing programs for supporting their transition into higher education.

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