



“Now I’m Not Afraid”: The Influence of Identity-Focused STEM Professional Organizations on the Persistence of Sexual and Gender Minority Undergraduates in STEM

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In comparison to work on women and historically excluded racial/ethnic minority students in science, technology, engineering, and math (STEM), research on sexual and gender minority (SGM) students in STEM is somewhat incipient. There is little scholarship available on SGM-focused STEM organizations (e.g., oSTEM). Building on the previous literature, we examine how SGM-focused STEM organizations provide social capital, both expressive (e.g., emotional support) and instrumental (e.g., academic resources), that helps students feel they fit in STEM and ultimately persist. We report findings from a large online survey with 477 SGM STEM undergraduates, 463 of whom participate in STEM organizations, which offers one of if not the largest study on the topic to date. We compare three types of identity-focused organizations, SGM-focused, women-focused, and race/ethnicity-focused, finding that they each provide expressive capital to SGM students. The organizations helped students cultivate supportive networks of peers like themselves who then help them feel they fit in STEM through similar but not identical mechanisms. For SGM-focused organizations, their assistance in helping students reconcile their SGM identities with their STEM identity was an important nuance tailored to SGM students’ needs. However, students described how SGM-focused organizations provided instrumental capital far less, which we posit may take a back seat to SGM STEM students’ expressive needs. Unfortunately, women-focused organizations were not always welcoming to SGM students, an issue not documented in race/ethnicity-focused societies. However, some identity-focused organizations established partnerships with other identity-focused organizations, highlighting the possible role of such collaboration in better serving SGM students, particularly those with minoritized ethnic/racial identities. Implications for research and practice are included.

Keywords: fit or belonging, inclusion, social capital, social networks, LGBTQIA+, oSTEM, societies, STEM (science, technology, engineering, and math)

INTRODUCTION

The STEM Climate Faced by People With Marginalized Sexual and Gender Identities

People with sexual minority (e.g., lesbian, gay, bisexual, asexual, pansexual) and gender minority (e.g., transgender, agender, non-binary) identities often face an unwelcoming environment in science, technology, engineering, and math (STEM). This often hostile environment is rooted in STEM's competitive and heteronormative "dude" culture, which is particularly harrowing for STEM gender minority students and faculty (Fisher and Waldrip, 1999; Seymour and Hewitt, 1999; Toynton, 2007; Antecol et al., 2008; Grunert and Bodner, 2011; Stout and Wright, 2016; Mattheis et al., 2019; Miller et al., 2020; Voigt and Reinholz, 2020; Cech and Waidzunas, 2021; Haverkamp, 2021; Palmer et al., 2021; Campbell-Montalvo et al., 2022b). This environment can lead to a lack of fit for sexual and gender minority (SGM)¹ students and faculty (Toynton, 2007; Bilimoria and Stewart, 2009; Cech and Waidzunas, 2011; Patridge et al., 2014; Cooper and Brownell, 2016; Cech and Pham, 2017; Mattheis et al., 2019; Cooper et al., 2020; Voigt, 2020; Friedensen et al., 2021; Lezotte et al., 2021; Campbell-Montalvo et al., 2022b). For SGM students, and women along with historically excluded racial/ethnic minority students, feelings of not being welcomed or belonging in STEM along with limited access to social capital comprise barriers to SGM students' STEM persistence (Schneider and Dimito, 2010; Smith et al., 2015; Cooper and Brownell, 2016; Stout and Wright, 2016; Hughes, 2018; Blosser, 2020; Voigt, 2020; Campbell-Montalvo et al., 2021, 2022b; Haverkamp, 2021).

Recent studies have shown that SGM students are more likely to not persist in STEM than non-SGM students (Cech et al., 2015; Hughes, 2018; Sansone and Carpenter, 2020; Maloy et al., 2022), and the exclusion of SGM faculty is particularly pronounced in later career stage STEM professionals (Rushworth et al., 2021). Unfortunately, SGM student persistence in STEM remains understudied. The lack of research on the topic is exacerbated by the paucity of demographic data on SGM identities among the U.S. STEM workforce (Freeman, 2020). Likewise, there is an indisputable scarcity of research examining the impact of STEM professional organizations on SGM STEM students and their persistence, and few mentoring programs are known to be available to explicitly serve SGM students in STEM (Beck et al., 2021). The present study, in which we report findings from a large online survey with 477 SGM STEM undergraduates, extends the literature on the topic by more closely examining a variety of social capital (i.e., expressive, instrumental) across identity-focused STEM organizations, such as those focused on SGM, racial/ethnic minority, or women students, to inform on how SGM STEM students are served by a range of organizations.

¹The authors use the term SGM (sexual and gender minority), widely used in psychology and public health literature, as we perceive it to be a more inclusive term than terms such as LGBTQ+, which only list certain sexualities or gender identities and represent the rest with the + sign (see e.g., Scholl et al., 2021). We acknowledge critiques of the term 'minority,' and in our use of SGM we use the term 'minority' to represent a marginalized relationship to dominant culture.

Research on Professional Organizations and Student Persistence

STEM professional organizations, by virtue of both their location of chapters on university campuses and their overarching purpose, comprise a powerful potential agent for broadening participation in STEM. In terms of identity-focused STEM organizations, findings are mixed about the role of those which are not SGM-focused. Specifically, Haverkamp (2021) reported that the race/ethnicity-focused Society of Hispanic Professional Engineers (SHPE) provided support to SGM STEM students, but that the women-focused Society of Women Engineers (SWE) was not always welcoming.

Recent research on SGM-focused STEM organizations (e.g., Out in Science, Technology, Engineering, and Mathematics [oSTEM]) highlights their impact on SGM STEM college students. For instance, Haverkamp (2021) interviewed 20 transgender and gender non-confirming (TGNC) engineering undergraduates. Findings showed that TGNC engineering students drew support from SGM-focused STEM organizations on campus, including oSTEM and the National Organization of Gay and Lesbian Scientists and Technical Professionals (NoGLSTP), with affirmation and acceptance being central themes in what attracts students to go to these sources for support (Haverkamp, 2021). In addition, Voigt (2020) conducted four sets of focus group interviews with a total of 17 queer-spectrum students having a range of SGM identities and from various STEM majors across four universities. Voigt underscored the role of oSTEM in impacting SGM students' experiences because it creates a "smaller, removed, and voluntary space for student participation, but it also seeks to foster the political mobilization that challenges the dominant assumption that STEM is intended for Straight white men" (p. 262). Similar to Voigt (2020), Haverkamp (2021) found that some of the main benefits of oSTEM included its relational resources about Queer issues, its provision of ingroup social networks and connections to outside allies, and how it empowered members by providing role models.

In terms of general STEM organizations, SGM students have reported feeling unwelcome in engineering campus clubs and activities, with standards of dress and pronoun usage being areas of particular concern (Haverkamp, 2021; Campbell-Montalvo et al., 2022b). In fact, STEM clubs and organizations that are not identity-focused (i.e., industry and discipline organizations) were places where students often reported that they did not fit and were unsafe to be out, and participation in them actually caused some students to question their persistence in STEM (Voigt, 2020).

Regarding organizations that are SGM-focused but outside of STEM (e.g., Out for Undergrad [O4U]), SGM students have reported feeling more supported by these campus clubs, activities, and people than they did in non-identity-focused engineering organizations (Haverkamp, 2021). On one hand, Fisher (2013) draws on the idea that a leading identity, such as Queer identity, can support other subordinate identities, such as mathematical identity. Thus, non-STEM SGM-focused organizations would be essential in SGM STEM student persistence by providing feelings of confidence with one's SGM identities that could serve as a strong foundation for STEM identity development.

Fischer writes, a “strong Queer identity creates a personal environment that is conducive to understanding and absorbing other information and knowledge” (Fisher, 2013, p. 113). On the other hand, Voigt (2020) argued that SGM-focused groups that are not STEM-related may pressure students to shed their STEM identity and prioritize their SGM identity, rather than holding both a STEM identity and queer identity at the same time.

We also draw on the body of scholarship on identity-focused STEM organizations that has examined the role of women-focused and race/ethnicity-focused STEM professional organizations. Research on women-focused and general engineering organizations has tied participation to increased persistence in women and students from ethnic/racial groups that are excluded in STEM (Hartman and Hartman, 2005; Smith et al., 2021). For example, drawing on 2,186 engineering undergraduates who participated in five rounds of an annual survey, Smith et al. (2021) demonstrated through inferential analyses that engineering undergraduates from historically excluded groups (i.e., African American/Black students, Latinx students, and American Indian students) who participate in engineering organizations were more likely to persist. The authors found that NSBE (National Society of Black Engineers) and SHPE (Society of Hispanic Professional Engineers) helped historically excluded students build their social capital in three areas:

- (1) academic and social integration through academic support, such as developing time management skills and tutoring, as well as social networking, such as meeting other students and engineers of color some of whom become friends and mentors; (2) connecting with industry internships and employment opportunities through attendance at national conferences; and (3) professional resources for career development such as improving leadership skills, resume writing, and interview skills (Smith et al., 2021, p. 8).

Additional analyses of a portion of the participants in Smith et al. (2021) work was conducted by Campbell-Montalvo et al. (2021) in which the authors interviewed a subsample of 55 women and historically excluded students. Here, Black students recounted dealing with anti-blackness in STEM, a group of disciplines known to be especially fraught with biases and discrimination (Bullock, 2017; Cedillo, 2018; Martin et al., 2019; Vakil and Ayers, 2019; Lee et al., 2020; McGee, 2020; Nxumalo and Gitari, 2021). An important manifestation of these biases is “stereotype threat,” which refers to “the immediate situational threat that derives from the broad dissemination of negative stereotypes about one’s group; the threat of possibly being judged and treated stereotypically, or of possibly self-fulfilling such a stereotype” (Steele and Aronson, 1995, p. 798). Stereotype threat has been a widely documented issue for women and ethnoracial minority students in STEM (Massey and Fischer, 2005; McGee and Martin, 2011; Beasley and Fischer, 2012; Gregory, 2015, 2016). Here, Campbell-Montalvo et al. (2021) found that a main mechanism through which people in the social networks of historically excluded students helped their persistence in STEM

was through the provision of warnings to expect bias from others—the provision of warnings helped students engage in stereotype management (McGee and Martin, 2011) to cope and continue on when the discrimination occurred.

At the same time, in another article on the 55 women and historically excluded interviewees, Campbell-Montalvo et al. (2022a) provided additional nuance to Smith et al.’s (2021) previous findings on the importance of NSBE. Specifically, NSBE provided Black students a range of social capital that was especially effective because it came from other Black engineers or mentors. Being around numerous other Black engineers served as an example that success in engineering could be done. In addition, academic resources like tutoring or career advice were particularly effective because they were provided by homophilous alters, or individuals who were similar to students (i.e., same race). Importantly, the specific types of advice and resources offered by Black people in a student’s network depended on their social proximity—the closer, more intimate relationships found in Campbell-Montalvo et al. (2021) provided students warnings of discrimination, the more distant, professional relationships provided through NSBE provided academic and career resources that were particularly effective because of who they were provided by (Campbell-Montalvo et al., 2022a). It is unknown as to how well this mapping of homophilous relationship types to support types might apply to SGM students.

We do know that similar mechanisms may be at play when it comes to women in STEM. Stout et al. (2011) tested of a model similar to our emphasis on homophilous alters that they call the “stereotype inoculation model.” The authors proposed that “contact with same-sex experts (advanced peers, professionals, professors) in academic environments” in STEM enhanced “women’s self-concept in STEM, attitudes toward STEM, and motivation to pursue STEM careers” (Stout et al., 2011, p. 255).

In interviews with 29 SGM students, Campbell-Montalvo et al. (2022b) found that SGM students often turned to other SGM students—or women and people of color when they did not have access to SGM STEM peers—for personal and academic advice. Yet having other SGM people with whom they could discuss their identity and STEM path was so important that students built their own homophilous social networks outside of their field when they did not have access to SGM STEM mentors. Given the demonstrated evidence of the function of homophilous alters in STEM persistence for historically excluded students and women, our research contributes by examining the role of homophilous alters in professional organizations and the types of support they provide on SGM STEM student persistence.

In sum, incipient research shows that oSTEM has supported SGM students in negotiating their identity and making relationships with other SGM STEM students with whom they can exchange and develop academic and career resources (Voigt, 2020; Haverkamp, 2021). Previous research suggests that there are parallels in the type of identity management that identity-focused STEM organizations, including oSTEM and NSBE, are able to confer upon members, particularly when the social capital is delivered by homophilous alters. These parallels, along with the dearth of research on SGM-focused STEM organizations, warrant further investigation using larger samples into how

various organization types may provide certain types of advice and resources, how they can encourage SGM student persistence, and what can be done to increase their reach.

Theoretical Orientation of the Present Study

To investigate the social mechanisms at play in how identity-focused STEM organizations, particularly those that are SGM-focused, influence the experiences and persistence of SGM STEM students, we mobilize theory on social capital, the advice and resources gained from others. We pay special attention to three forms of social capital: participatory, instrumental, and expressive. Participatory social capital includes the networks and resources gained through participation in organizations that have as part of their mission a goal to help members accrue a variety of capital to help them succeed (Skvoretz et al., 2020). Expressive social capital includes emotional support and encouragement to help people fit in or feel welcome, while instrumental social capital includes more direct resources, such as academic knowledge or advice on career opportunities, to help with success (Puccia et al., 2021). In previous research with women and historically excluded students, both forms of social capital provided by STEM organizations were shown to be crucial to students' declaration and persistence in STEM majors and their path into the workforce (Skvoretz et al., 2020; Campbell-Montalvo et al., 2021, 2022a,b; Puccia et al., 2021; Smith et al., 2021).

We extend this body of previous work to our examination of the role of identity-focused STEM professional organizations on SGM student persistence, adopting Smith et al.'s (2021) classifications as an analytical lens of STEM organization grouping by type. This classification model includes their framing of organizations as women-focused and race/ethnicity-focused. In the present study, we add the framing of SGM-focused organizations under our articulated umbrella term of identity-focused organizations.

We contribute to the recent focus on the role of SGM-focused STEM organizations by analyzing data from a large survey of SGM STEM undergraduates. Given the STEM climate for SGM students and their exclusion in the field, along with the role of social capital from professional organizations in student persistence, our goal is to better understand how identity-focused organizations (i.e., SGM-focused, women-focused, race/ethnicity-focused) may nurture SGM student capital and encourage persistence. We surveyed 477 SGM students, of whom 463 participate in professional STEM organizations—one of or possibly the largest sample of SGM STEM students who participate in a STEM professional organization to date. We address the following research questions, with an emphasis on organizations that are STEM-related:

- (1) What *expressive* social capital do SGM students obtain from identity-focused organizations that help them persist in STEM?

- (2) What *instrumental* social capital do SGM students obtain from identity-focused organizations that help them persist in STEM?
- (3) What barriers to participation in identity-focused organizations did SGM students encounter?

Our aim is that outcomes of this research add to the discussion of how STEM professional organizations can broaden participation in STEM, especially for diverse SGM students.

METHODS AND PARTICIPANTS

Recruitment

We first recruited survey respondents who were currently enrolled STEM undergraduates from six partnering national professional organizations. These six partners were either:

- non-STEM SGM-focused organizations,
- STEM SGM-focused organizations,
- STEM women-focused organizations, or
- STEM non-identity-focused organizations with an active subdivision of or previously demonstrated interest in SGM students.

To increase the ethnic/racial diversity of our sample, we then recruited respondents from two additional STEM national professional organizations with a substantial number of Black and Latinx students.

Each of the eight total organizations was asked to send our IRB-approved recruitment statement to their membership. Organizations did so by distributing the recruitment statement using their listserv and/or social media accounts and/or including it in their e-newsletter. The recruitment statement explained the purpose of the study and the eligibility criteria (i.e., students who identified as LGBTQPIA+ and were enrolled in a STEM major). Students were given the option to enter their university email address to win one of twenty \$100 gift cards. The survey was closed after 2.5 months.

Survey Demographic Measure

Student demographic characteristics were identified via items asking about students' sexual and gender identities as well as their racial/ethnic identities. The sexual and gender identity items were developed with guidance from the literature (particularly, Strunk and Hoover, 2019) and were based on analysis of 29 interviews the research team conducted with STEM SGM students during which the identity items were piloted and participant feedback was sought to inform the development of the survey. To measure sexual identities on our survey, we included an item that read, "Your sexual orientation is... (select all that apply)" and participants were able to check one or more boxes on the following list, with a final choice in which they were able to write in any additional identities:

- Asexual
- Bisexual
- Gay

- Heterosexual
- Lesbian
- Queer
- Questioning
- Pansexual
- If there are other/additional identities, please specify _____

Respondents identified 55 different configurations of sexuality, in addition to 10 write-ins under ‘Other’ (e.g., ‘aromantic,’ ‘biromanti,’ etc.). Twenty-four of the 55 (44%) configurations had a single person with that specific combination. This speaks to the fluidity and diversity of the sexual identities of participants in the sample. These 55 distinct combinations were re-classified into seven categories: bisexual; multiple sexual identities (MSIs); lesbian; queer/pansexual; asexual; gay; and other. We retained four of the original sexuality categories because respondents reported those identities alone in sufficient quantities to warrant retention: bisexual (31%), lesbian (14%), asexual (6%), and gay (4%). All respondents who reported more than one sexual identity were coded as Multiple Sexual Identities (MSI) to reflect their multi-dimensional sexuality (28%). Respondents who solely identified either Queer or Pansexual were combined into a single variable (11%). This combination was to reflect that both terms, in terms of sexuality, refer to fluid, inclusive understandings of sexual identity and attractions to more than one gender. The remaining respondent configurations were coded as Other and included those who marked Other originally, or who reported Questioning or Heterosexual.

Similarly, to measure gender identities on our survey, we included an item that read, “Your gender identity is... (select all that apply)” and participants were able to check one or more boxes on the following list, with a final choice in which they were able to write in any additional identities:

- Agender
- Gender Non-binary/Genderqueer/Gender Non-conforming
- Intersex
- Man
- Woman
- Cisgender
- Transgender/Trans
- Bigender/Pangender/Multigender/Gender fluid
- If there are other/additional identities, please specify _____

Respondents identified 25 distinct configurations of gender identity (plus three ‘Other’ write-ins: ‘queer,’ ‘I’m mostly a girl but I’m also just chilling,’ and ‘questioning’). Eleven of the configurations (44%) were unique to one individual. The 25 configurations were re-classified into five categories: woman; non-binary/transgender; man; multiple gender identities (MGIs); and other. Those who identified themselves as woman or woman and cisgender were coded as Woman (77% of sample²). The same combination was used to denote Men (5%). We interpret both the Woman and Man categories as representative

²Figures do not add to 100% due to rounding.

of individuals who identify with those gender categories and do not presume they are cisgender. Respondents who reported singular or combinations of non-binary, transgender, or bigender identities were coded as non-binary/transgender (8%). Individuals who reported multiple gender categories (with the exception of woman + cisgender or man + cisgender) were coded as MGI (4%). The Other category included individuals who identified as Agender, Cisgender (with no other designation), or Other (5%).

Here, declaration of the cisgender qualifier did not categorize a student as MGI unless they had two gender identities. Participants who identified as trans or trans + woman or trans + man were categorized as trans. Participants who only identified as woman were categorized as women. This likely means that some trans women participants did select solely the identity of woman. We chose to retain those selections given that that is how participants thought of themselves. For example, 43% of participants marked woman and 34% marked cisgender and woman. We put those participants all in the woman category without calling it cisgender, because they identify as women.

Categorization of Identity Variables

Our survey allowed participants to select all identities they held³, and any reporting of data using such an item would necessarily need to regroup in order to facilitate quantitative description. For the descriptive analysis, we acknowledge that collapsing larger groupings of identities into smaller grouping does erase identity, so we balanced that drawback with the power that comes from using smaller groups to describe participation in the STEM organizations. The re-classification is also necessary for future quantitative analyses, which require a certain population size; positioning the current study to articulate with our forthcoming work using the same categories to support robust interpretation across datasets. For the qualitative examples provided in this study, students’ full chosen identity markers are included with their quotes.

Allowing the selection of more than one identity and giving space to write additional identities promoted the exercise of participant agency in the survey. For both sexual and gender identities the team engaged in several rounds of back-and-forth discussion and coding about how to group the multitude of responses. The discussion was based on the team’s previous first review of the demographic data, their previous research on the topic, and the existing literature, culminating in a codebook using the criteria mentioned earlier. The subsequent creation of the categorization schemes, particularly the MSI and MGI groupings, supports us in honoring the complexity of our respondents’ sexual and gender identities. Our use of the MSI and MGI categories might be a novel categorization that seeks to retain identities selected by participants, to combat the erasure inherent in data recategorization. In this way, this can be seen as a strength of the design of the present study.

³Raw data are available upon request if readers would like to see the range of identities in light of the recategorization.

Rich scholarly debates are ongoing regarding how SGM identities are defined and measured (Vogler, 2021; Guyan, 2022), though consistent measures and data regarding SGM identities, particularly in STEM education research, have not been established (Freeman, 2020). One contribution of our work lies in the sharing of our SGM identity survey items here to help advance measurement in the field.

Survey Items on STEM Organization Participation

The data analyzed for this study include student responses to two survey items. The first was a close-ended survey item in which participants were asked about the organizations in which they participated, “Which of the following STEM organizations have you participated in? (Select all that apply) You do not have to be a member, you could have attended or participated in events/activities.” Participants were able to check one or more boxes on the following list, with the final choice permitting them to write in any additional organizations.

- Out for Undergrad (O4U)
- Out in Science, Technology, Engineering, and Mathematics, Inc. (oSTEM)
- National Organization of Gay and Lesbian Scientists and Technical Professionals (NOGLSTP)
- National Society of Black Engineers (NSBE)
- Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS)
- Society of Hispanic Professional Engineers (SHPE)
- Society of Women Engineers (SWE)
- Engineering industry or discipline specific organizations (e.g., SAE International, Institute of Electrical and Electronics Engineers [IEEE]), please specify _____
- National science student chapters/organizations/clubs (e.g., the American Chemical Society [ACS]), please specify _____
- Other, please specify _____
- None

The second survey item we analyzed was an open-ended item which read, “Please describe how your participation in _____ has contributed to your progress as you pursue your STEM degree.” Using Qualtrics’ piped text feature, the blank was automatically filled in with the name of the organization in which participants had reported participating in the earlier item. If students had participated in more than one organization, they

received the prompt asking how their participation contributed to their progress for each organization, displayed one at a time.

Analysis

We calculated descriptive statistics on the first survey item that asked in which organizations respondents participated. On the second open-ended item asking about how students’ participation in organizations contributed to their progress in STEM, we analyzed data related to responses in the identity-focused organization choices provided on the survey using thematic analysis (Braun and Clarke, 2006). Six members of the research team met regularly to review the data, discuss approaches to data analysis, and discuss ideas for codes and themes that might generally apply to the full dataset. In focusing on the data presented here, two team members created a codebook based on an initial review of the dataset and the team’s previous discussions, research, and the literature, which has previously highlighted the role of (1) expressive and (2) instrumental social capital in a range of areas, including in engineering students’ major declaration (Puccia et al., 2021), in their academic resources (Smith et al., 2021), and in their fit (Campbell-Montalvo et al., 2021, 2022a,b). We were also interested in understanding (3) the barriers to participation in organizations that students reported, since such information could potentially be used to increase the reach of the organizations.

Once the codebook was established, the two members of the research team reviewed the data of focus to articulate an operationalization of and examples of each code that would be used, and to confirm the codes would be suitable for use with the data. Then, one member of the research team organized the data by applying one or more of the three codes to student responses. The two members of the research team met several more times to review and discuss the coding process, clarify code meanings, and confirm codes used on the data. The final codebook is shown below (Table 1). The two team members continued to meet to discuss how the coded data were interrelated, associating the organized data into themes. The themes were then parsed out by organization type (i.e., SGM-focused, women-focused, or race/ethnicity-focused) and presented in this manuscript using illustrative examples.

In the end, the researchers reached consensus about the ability of the codebook to allow for the organization of data in relation to the research questions, demonstrating the reliability of our analysis. Our interview questions were based on previous research, as articulated earlier, supporting the

TABLE 1 | Codebook used for analyzing qualitative data.

| Code | Definition/examples |
|-----------------------------|--|
| Expressive social capital | Sense of belonging, community, likeminded, support, identity, safe space, “not alone,” encouragement, motivation, inspiration, outreach, giving back |
| Instrumental social capital | Mentoring, academic support (tutoring, advice about classes), professional networking, professional development/career-specific skills, internships/jobs, scholarships |
| Barriers to participation | Time, scheduling conflicts, lack of fit, lack of interest |

TABLE 2 | Organization participation by race/ethnicity, sexual identity, gender identity (N = 477).

| Identity | n (%) | O4U (n = 11) | oSTEM (n = 88) | NoGLSTP (n = 4) | NSBE (n = 69) | SHPE (n = 51) | SWE (n = 415) |
|------------------------|-----------|--------------|----------------|-----------------|---------------|---------------|---------------|
| Race/Ethnicity | | | | | | | |
| White | 285 (60%) | 6 | 55 | 1 | 11 | 17 | 263 |
| Asian/Pac. Islander | 55 (12%) | 1 | 11 | 1 | 5 | 2 | 52 |
| Multiracial | 53 (11%) | 0 | 10 | 0 | 9 | 9 | 46 |
| Black | 41 (9%) | 1 | 5 | 0 | 39 | 8 | 15 |
| Latinx | 23 (5%) | 1 | 2 | 1 | 3 | 11 | 21 |
| American Indian | 11 (2%) | 1 | 3 | 0 | 2 | 1 | 10 |
| Other | 9 (2%) | 0 | 1 | 1 | 0 | 1 | 7 |
| Sexual Identity | | | | | | | |
| Bisexual | 148 (31%) | 1 | 15 | 1 | 22 | 20 | 129 |
| Multiple (MSI) | 134 (28%) | 3 | 34 | 1 | 14 | 11 | 119 |
| Lesbian | 68 (14%) | 2 | 16 | 0 | 7 | 4 | 62 |
| Queer/Pansexual | 51 (11%) | 3 | 12 | 1 | 9 | 3 | 42 |
| Other | 31 (7%) | 0 | 6 | 0 | 5 | 4 | 30 |
| Asexual | 28 (6%) | 0 | 2 | 1 | 3 | 3 | 25 |
| Gay | 17 (4%) | 2 | 3 | 0 | 9 | 6 | 8 |
| Gender Identity | | | | | | | |
| Woman | 368 (77%) | 6 | 61 | 2 | 40 | 34 | 341 |
| Non-binary, Trans | 38 (8%) | 2 | 9 | 1 | 7 | 3 | 28 |
| Man | 26 (6%) | 2 | 6 | 0 | 16 | 8 | 8 |
| Other | 24 (5%) | 0 | 6 | 1 | 2 | 2 | 22 |
| Multiple (MGI) | 21 (4%) | 1 | 6 | 0 | 4 | 4 | 16 |

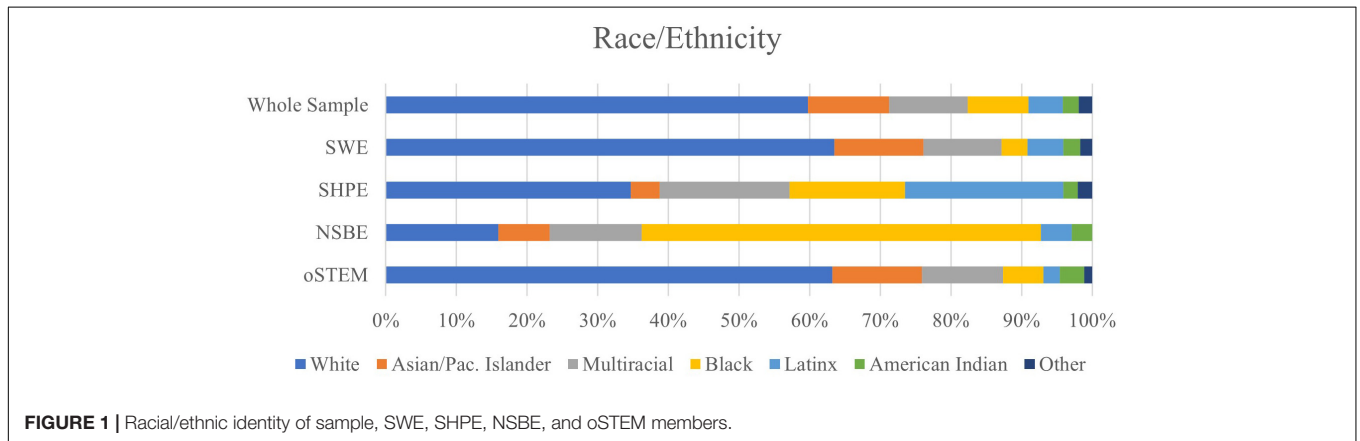


FIGURE 1 | Racial/ethnic identity of sample, SWE, SHPE, NSBE, and oSTEM members.

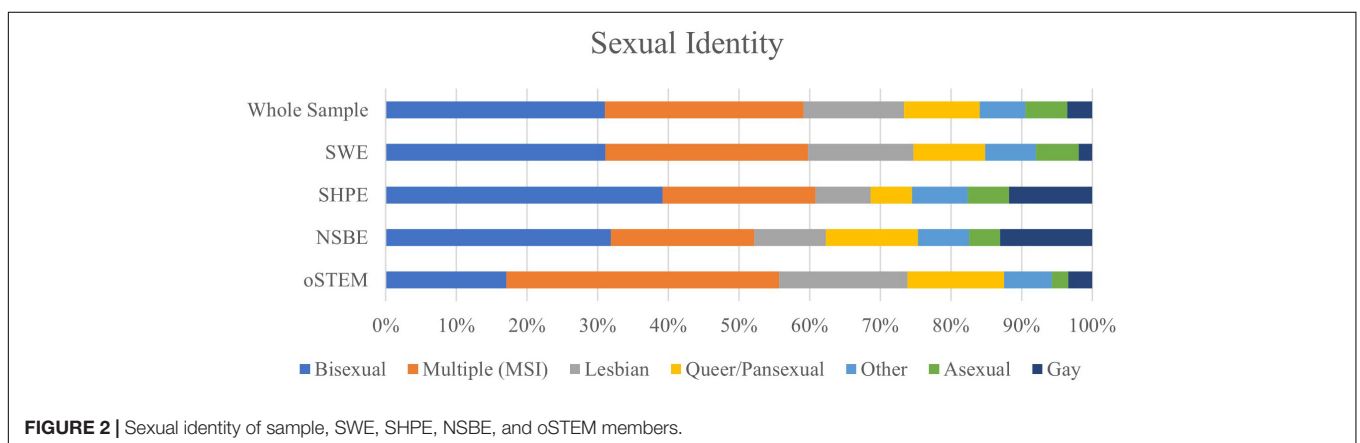


FIGURE 2 | Sexual identity of sample, SWE, SHPE, NSBE, and oSTEM members.

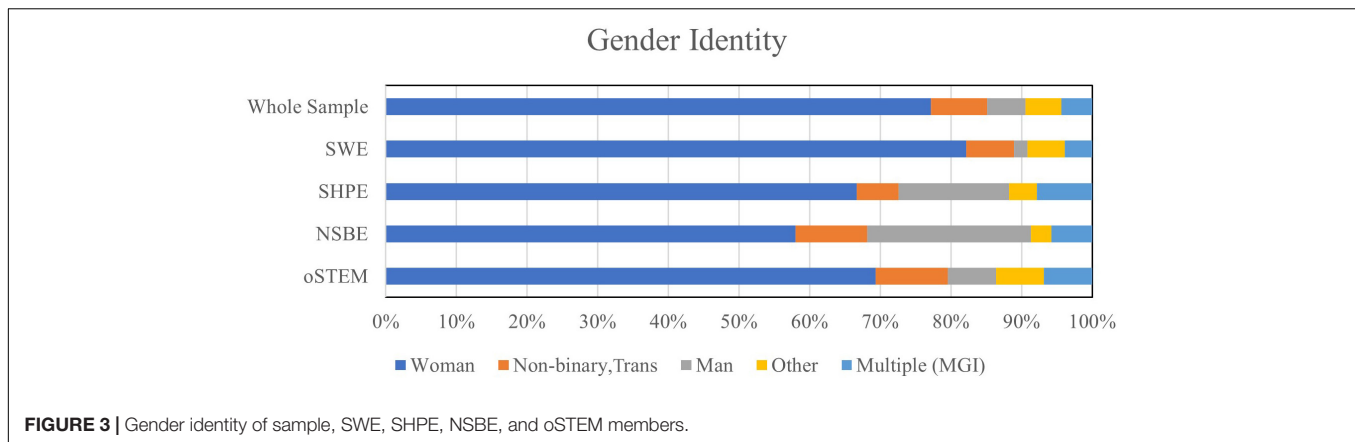


FIGURE 3 | Gender identity of sample, SWE, SHPE, NSBE, and oSTEM members.

credibility of our work. By using robust probing techniques in interviews and implementing the recruitment procedures we did to engage a diverse sample, we bolstered the transferability of our findings to additional contexts exploring how identity constellations intersect with social capital to impact outcomes. Our results are confirmable since they emerge from our multi-step analysis process and are presented in participants' own words. Additionally, our results are also dependable given that we expect other scholars researching SGM students in STEM will obtain similar data on student experiences in these organizations (Nowell et al., 2017).

Participants

In terms of race/ethnicity, the sample was 60% white students ($n = 285$), 12% Asian/Pacific Islander students, 11% multiracial students ($n = 53$), 9% Black students ($n = 41$), 5% Latinx students ($n = 2$), 2% American Indian students ($n = 11$), and 2% other students ($n = 9$). With respect to sexual identity, the sample was 31% bisexual students ($n = 148$), 28% MSI students ($n = 134$), 14% lesbian students ($n = 68$), 11% queer/pansexual students ($n = 51$), 7% other students ($n = 31$), 6% asexual students ($n = 28$), and 4% gay students ($n = 17$). With respect to gender identity, the sample was 77% women students ($n = 368$), 8% non-binary/trans students ($n = 38$), 6% men students ($n = 26$), 5% other students ($n = 24$), and 4% MGI students ($n = 21$). Of the seven provided as a choice, students participated in the following six identity-focused organizations: SWE ($n = 415$, 87%), oSTEM ($n = 88$, 18%), NSBE $n = 69$; 14%), SHPE ($n = 51$; 11%), O4U ($n = 11$; 2%), and NoGLSTP ($n = 4$; 1%). **Table 2** shows the number of students who participated in the organizations listed as a choice on the survey, by student demographics. The three stacked bar graphs that follow show the racial/ethnic, gender, and sexual identity breakdown of participants in the four largest organizations (**Figures 1–3**).

FINDINGS

Overview

In this section, we detail findings related to our three research questions on how SGM STEM students receive expressive and

instrumental social capital from identity-focused organizations and may encounter barriers to participation. **Table 3** presents a concise representation of the findings related to these research questions.

To help the reader get an idea of the level of endorsement of themes among the sample, **Table 4** depicts the amount of responses about student participation in societies that were coded as expressive or instrumental social capital or barriers to participating in the societies of focus. Responses could have been coded using none, one, two, or three of the codes.

Expressive Social Capital: Sexual and Gender Minority-, Women- and Race/Ethnicity-Focused Organizations Help Sexual and Gender Minority Students Negotiate Identity to Fit in STEM

Expressive social capital helps students feel welcome in STEM and encouraged to continue toward their STEM goals. SGM-, women-, and race/ethnicity-focused organizations each provided expressive capital to SGM students from a range of SGM and ethnoracial groups, albeit in varying ways. In the case of each identity-focused organization (i.e., SGM-focused, women-focused, race/ethnicity-focused), the base of the capital stemmed from the organization's development of a safe community network where students with particular identity sets were welcome and had the opportunity to negotiate how they fit into STEM given their identities (i.e., as SGM students, as women, as ethnoracial minority students [particularly Black students]).

Sexual and Gender Minority-Focused Organizations Contribute Most in SGM Identity Negotiation

Sexual and gender minority-focused chapter organizations, namely oSTEM, helped SGM students stay in STEM in two main ways:

- They provided an infrastructure for students to network with other SGM students, creating a safe and supportive community.

TABLE 3 | Main research findings.

| Research question | SGM-focused | Women-focused | Race/Ethnicity-focused | Overall identity-focused |
|---|--|--|--|---|
| (1) What <i>expressive</i> social capital do SGM students obtain? | Provided infrastructure for networking with other SGM students, creating a supportive community. Helped students understand themselves in terms of their SGM identities and feel belonging in STEM at the same time. | Provided a supportive network in a comfortable space where students could express identity. Students felt motivated from being part of an organization with women in a safe space, with role models who show it can be done, and with a history of women's excellence. | Provided a network of support of Black engineers, who also provide an example that success in engineering can be done. Provided a sense of belonging and increased confidence. | Each helped expand social networking with homophilous others who provided capital for identity negotiation in STEM. Each helped motivate students as they became part of something greater than themselves and helped others in STEM. |
| (2) What <i>instrumental</i> social capital do SGM students obtain? | Students less often reported receiving instrumental social capital, and what was received centered on careers. | Provided extensive academic and career support. This support was often tailored toward women and ground in the development of networks and networking. | Provided robust academic and career resources ground in the development of networking, often with same-race engineers. | Students wrote far less about how SGM-focused organizations helped with academics and/or career. |
| (3) What were barriers to participation? | SGM students did not report exclusion. | Did reproduce cultures of exclusion toward SGM students. | Issues of fit were rare, and relation to SGM identities not substantiated. | Some organizations collaborated with other organizations to better serve SGM students. |

TABLE 4 | Count of codes applied to data across the three society-types.

| Society type | Expressive social capital code | Instrumental social capital code | Barriers code |
|------------------------|--------------------------------|----------------------------------|---------------|
| SGM-focused | 71 | 9 | 2 |
| Women-focused | 276 | 142 | 20 |
| Race/ethnicity-focused | 69 | 42 | 5 |

- They were especially valuable in helping students understand themselves in terms of their gender and sexual identities and feel belonging in STEM at the same time.

For example, regarding how oSTEM helped her connect to other SGM students which contributed to her persistence in STEM, a white bisexual queer woman wrote:

My participation in oSTEM connected me to the only other out student I have met in my major. We are friends now and have been able to support each other in ways straight/cis students and faculty cannot. This solidarity makes me more willing to stay in engineering.

Likewise, an Asian queer pansexual non-binary student described their participation as the Conference Chair of oSTEM, highlighting the value of empathy across members and how it helped them stay in STEM:

Our weekly meetings gave me a safe space where I was certain that a majority of the members could empathize with the struggles of queer students (especially non-binary students) in the STEM field. Without this mental and emotional support provided by members of this organization, I may not have been able to continue in STEM.

In addition, in discussing specifically how the community of oSTEM helps negotiate STEM fit with SGM identities, a Black cisgender lesbian woman shared:

It has given me confidence to be my full self at all times while pursuing this degree. Going to the conference has given me the encouragement to truly believe in myself and my abilities. My identities make me who I am, but they are not all that I am. I can do all things despite the harsh past that I come from. Being comfortable with oneself enables students to persist.

Also connecting a sense of community with the dual identity acceptance of SGM and STEM to progress in STEM, a Muscogee and white bisexual woman stated, "oSTEM has showed me that I am not alone and has given me a community in which I can be honest about two major parts of myself." At the same time, an Asian lesbian queer woman wrote that oSTEM has "given the best type of education related to the intersectionality of being LGBT+ and not hiding your sexuality even in a professional setting while at the same time not outing yourself and ruining professional work." Likewise, a white queer lesbian woman wrote of oSTEM, "It is a pretty solid reminder that my experiences and identity aren't necessarily isolating, and that there is a support network for me." Similarly, a Latinx pansexual woman described her experience with O4U in helping her negotiate her own identities personally and in STEM:

I went to two O4U Engineering Conferences and they helped me a lot. After the first conference I was able to come out and be more happy with myself, which helped me to be better in my classes and general life. To be a

successful professional you have to be authentic and to be sure of who you are. I was afraid of how being part of the LGBTQ+ community could negatively affect my life (academic and professional). Now I'm not afraid and I try to inspire other people.

A white bisexual queer gay man comparably described his experience in O4U, "I attended the O4U Engineering conference, and it really opened my eyes to the importance of my two identities, STEM and LGBTQ+. After the conference I felt more comfortable with who I am." An Asian queer pansexual non-binary student also talked about how an SGM-focused organization helped them understand their identities:

I attended the NOGLSTP conference in the spring of 2019 and attended educational sessions about the science of gender, which helped me figure out different aspects of my gender identity and validate some of my feelings about my own biological sex.

These comments show that SGM-focused organizations offered expressive social capital especially attuned to community, which was particularly useful in SGM students integrating their SGM and STEM identities.

Women-Focused Organizations

Women-focused organizations helped students persist in STEM via two key mechanisms:

- They provided a supportive network in a comfortable space wherein students could express their identity outside of the hetero-cisgender-male STEM environment.
- Students received feelings of motivation from being part of an organization with women in a safe space, with strong role models who show it can be done, and with a history of women's excellence in STEM.

Writing about the influence of SWE in making space for women in engineering, a white pansexual cisgender woman described the importance of this community in light of the engineering environment: "SWE has served as a place for female engineering majors to gather and exist without worrying about our male peers infringing on our existence or worrying about spinning our mannerisms to appease them." Likewise, a white woman who self-describes her sexual identity as fluid and unlabeled wrote how SWE helped her to feel like she belonged in engineering, "I struggle in engineering as both a queer person and a woman. My close friends are mostly all other women in my major, and we attend occasional SWE events together, which always makes us feel like we belong in the engineering community." Similarly, a white pansexual cisgender woman wrote, "While it was not explicitly focused on sexual orientation, having a community of women who were able to relate to my struggles and share their own experience helped me feel like I was not alone." A white bisexual woman shared that SWE provided "validation as a gender minority." For some students, SWE extended feelings of community to identities outside of gender, as an Asian and white demisexual

cisgender woman wrote, "SWE has taught me that there is value in my identity as a woman in engineering. The values I've learned in this club also translate to how I express my sexuality identity and identity as a person of color." A Middle Eastern gay man also emphasized sense of community and safety: "SWE helped build a family for me at school that I can feel safe in and connect with. Helped ground me and be myself."

Students in SWE wrote about how they gained motivation and inspiration to persist in STEM from being around women in a safe environment, meeting and becoming role models for others, and taking part in the history of women in STEM promoted by SWE. A white bisexual cisgender woman said of SWE, "Having a safe space with other women who experience the same issues helps motivate me." A Black non-binary bisexual queer pansexual student described the motivation they got from the organization, "SWE has given me motivation to work harder and engage more with fellow engineers in my field." Also describing SWE's impact on her motivation, an Asian and white bisexual cisgender person wrote, "I've felt much more empowered and motivated to do my best in school. They also make me feel reassured that I can do this, and everything will work out." Again connecting the safe space to motivation, as well as highlighting role models, a white bisexual woman wrote, "Being in SWE provides me with a safe place where I can discuss both academic and personal issues with a set of strong, passionate STEM role models who truly want to help me succeed." An Asian and Latinx lesbian cisgender woman's response echoed the importance of role models in SWE, "They are a strong network of role models that show me that my dreams really are within reach." A white queer and questioning cisgender woman located SWE's history as a source of her motivation in its legacy, "I love knowing that there are women who came before me and did the same things that I am doing now." Similarly, a white bisexual queer woman wrote, "SWE is the main reason I continued to pursue engineering. Being part of a cause greater than myself or even my education inspires and encourages me to get my degree." These examples show how SWE particularly aided women in fitting into STEM by providing a safe space and buttressing feelings of motivation from being around women, role models, and the historical legacy of SWE.

Race/Ethnicity-Focused Organizations

Race/ethnicity-focused organizations, particularly the most often cited NSBE, helped students cultivate expressive social capital. These organizations helped students persist in engineering by:

- Providing a network of support of Black engineers, who also provide an example that success in engineering can be done even though there are few Black engineers.
- Providing a sense of belonging and increased confidence in engineering.

For example, in writing about how NSBE increases fit in light of the lower numbers of Black students in engineering, a Black asexual pansexual man wrote, "NSBE provides a sense of belonging being a person of color in a field that there are few in." Likewise, a Black bisexual woman stated, "NSBE has been one of my biggest support systems as there are not many

Black students on campus.” A Black and white bisexual cisgender woman highlighted her confidence increase because of this, “My participation in NSBE has helped increase my confidence in myself as one of the few, and sometimes only black person in my STEM classes.” In addition to the scarcity of Black engineering students, the lack of women engineers was also a concern NSBE helped some students face; another Black bisexual woman wrote of how it built her confidence as a Black woman in STEM, “NSBE has helped me find my place in a field dominated by men, I have found friends and a safe place. This group has helped me build my confidence being a Black woman in STEM.”

National Society of Black Engineers sustained fit by providing students the opportunity to see and be around other Black students in STEM. For instance, a Black gay transitioning woman wrote of NSBE, “Seeing other people who look the same as me and have similar cultures as me succeeding in what I want to do has pushed me to love my major even more.” Similarly, a Black lesbian cisgender woman in NSBE said, “It’s nice to see people of my racial background pursuing engineering because I rarely ever see that in my classes.” At the same time, a Black bisexual non-binary student recounted how NSBE empowered them, “It was uplifting and empowering to see Black people like me. . . I felt less like an outsider attending club meetings.” A Black gay man also wrote of the motivation he drew from NSBE and being around Black engineers, “NSBE has kept me motivated and inspired to see other people of color succeed in the STEM field.” A Black and Latinx bisexual queer woman who identifies as multigender⁴ described how NSBE increased her confidence by enabling her to develop a network of colleagues who provide resources that help her persist in engineering:

I have been a part of NSBE since my freshman year, and it really has brought me closer with the Black community, improved my confidence, and helped me network with numerous engineers across the country. Now, with a strong network of people, I am able to get through classes with classmates that I have met through the organization.

Similarly, on NSBE’s impact on his confidence, a Black asexual queer cisgender man wrote of NSBE’s long-term effect on his engineering fit:

They have helped mold my confidence to pursue my education. They inspired as far back as high school and were the living example I needed of students who at a glance I knew could graduate. I needed these examples to help me see those qualities in myself.

One participant wrote about the benefits to feelings of belonging from SHPE. A Black bisexual woman stated, “SHPE has supported me because it has shown me that all minorities care and support one another.” Together, these excerpts show how race/ethnicity-focused organizations, particularly NSBE, helped engineering students of color, particularly Black students, develop a network of students like themselves and see engineering as a place for them.

⁴Participant selected Bigender/Pangender/Multigender/Gender fluid on the survey; for readability on the quoted examples, we use multigender.

Expressive Social Capital: Amplifying Others’ Voices in Organizations Raises One’s Own

In addition to helping students persist in STEM by helping them negotiate their identities and develop networks, students experienced emotional benefits from these organizations at the same time they put in the work to run them. Specifically,

- Students received feelings of contributing to a greater purpose through organizations as they advocated and encouraged other students in STEM.

For instance, when asked how the organization influenced their STEM progress, a white bisexual non-binary woman mentioned the advocacy role of SGM-focused organizations, responding, “oSTEM has been essential in advocating for the LGBTQ student body, since we are the only LGBTQ organization on campus.” Likewise, a white bisexual lesbian queer woman wrote, “I founded the oSTEM chapter at my institution and was able to help others in the LGBTQIA+ community find a voice and advocate for them.” A white bisexual gay queer man described how he got involved in helping SGM students:

I was inspired in part by attending the O4U conference, so I joined the e-board of my school’s oSTEM chapter. I have attended a couple of conferences, and I am passionate about providing opportunities/serving as a guide for those just entering STEM and the LGBTQ+ community, or allies who wish to know how they can help.

A white bisexual gay queer man similarly described his experience in O4U, “I had more drive to make a difference for the STEM and LGBTQ+ community.”

On the role of women-focused organizations, a Black bisexual queer pansexual non-binary student described their experience in SWE advocacy, “As the vice president of the Society of Women Engineers, I have a partial responsibility in planning meetings, and engaging students on campus to advocate for women in engineering.” A white queer questioning cisgender woman additionally described helping incoming students in SWE, “I love knowing that I can be a role model for the younger students, and that they will look up to me and know that I have made their path just a little bit easier.” Similarly, a white lesbian non-binary student wrote that becoming a role model in SWE was motivating, “SWE allows me to encourage others and see that I am a role model to some so therefore I should keep going.” Likewise, a white bisexual queer woman wrote of the inspiration she felt by participating in SWE to “serve as an example to other female identifying students that they can do it too!” A Latinx pansexual woman shared her experience in SWE and how her involvement inspired others:

I’ve met amazing people and mentors, I’ve inspired people and I’ve been inspired too. . . This year I got to be part of a panel as a Latinx/Latino/Pansexual person, representing the LGBTQ+ community in the “Diversity and Inclusion in the Latinx Community.” SWE gave me tools that I couldn’t find in any classroom and I’m grateful for it.

Of race/ethnicity-focused organizations, a Black asexual cisgender woman wrote about giving back to the university, “NSBE ... allows me to take a role of leadership and give back to the campus.” A Black lesbian cisgender woman similarly wrote about her joy in giving others someone to look up to in NSBE, “Interacting with younger students in the organization motivates me to continue being great so that they have someone to look up to. I’m currently the president at my university and I love it.” Similarly, an Asian and Latinx lesbian cisgender woman identified outreach opportunities through volunteering in SHPE as influential on her STEM progress, “The volunteer opportunities remind me why I chose to be in STEM.” Thus, these comments show how participating in these organizations motivates students to persist in STEM as they advocate for and welcome new students like themselves into the field.

Instrumental Social Capital: Providing Career Opportunities Is a Strength of Women and Race/Ethnicity-Focused Organizations

Instrumental social capital gives students “insider knowledge” about how to succeed in STEM. Organizations provided SGM students resources focused on aiding them in their academics and in their careers. Academic support came in the form of tutoring, organized study groups, and upper class students offering advice. Respondents mentioned that their organizations assisted with developing professional skills related to their future careers as well. Overall, students highlighted instrumental capital somewhat less robustly than expressive capital, particularly in SGM-focused organizations. Findings primarily showed:

- In comparison to race/ethnicity-focused organizations and women-focused organizations, students wrote far less about how SGM-focused organizations helped with academics and/or career.

In terms of SGM organizations, students less often reported that they offered instrumental social capital, what they did offer centered on career advancement. For instance, a white lesbian cisgender woman shared how oSTEM provided connections to career opportunities that would be safe for her given her SGM identity, “oSTEM has provided career opportunities with LGBTQIA friendly organizations and has provided me with LGBTQIA professional connections.” In addition, an Asian queer trans student identifying also as transmale described, “My oSTEM connects me with different STEM students of different ages and backgrounds. I am able to ask LGBT upperclassmen for advice regarding career options and academics.” More generally, a white lesbian woman indicated, “O4U helped me get a full-time job after graduation.” While sparse, these comments show the potential of SGM-focused organizations in impacting their members’ academic and career paths.

Members of SWE wrote more than those of oSTEM about receiving academic and career support. This support was often tailored toward women and ground in the development of networks and networking. In terms of academic support, a white

bisexual non-binary⁵ and multigender student wrote that SWE “helped me find people to study with and hold me accountable.” A white lesbian cisgender woman described:

Society of Women Engineers provided me with a network of women to support me in my classes. I was given study tips, tutoring, support for difficult assignments, resources to help me succeed, and de-stressing activities during exam weeks. SWE is the main reason I decided to remain an engineering student.

Regarding career support, a white bisexual woman wrote that “SWE has provided helpful lectures and guest speakers to talk about how women can move forward in their STEM career.” A Middle Eastern bisexual woman wrote of the skills she developed, “SWE helps a lot with getting jobs and preparing for the application process.” A white bisexual questioning cisgender woman also described the professional skills SWE afforded her as a woman and said, “I attend SWE professional meetings where I learn about companies that could hire me, how to behave in the industry.” Similarly, an Asian bisexual woman wrote, “At SWE general meetings we discuss how to have success in the classroom and also how to learn the soft skills needed to network.” A Latinx bisexual cisgender woman wrote about the additional experiences SWE offered that helped in her career path, “SWE has helped me step into leadership positions which enabled me to find internships/co-ops.” A Latinx pansexual woman also discussed the leadership skills and job opportunities she has received through her involvement in SWE:

I’m pretty much sure that I’m the leader I am today because of all the roles and opportunities I got as a SWE member...I’ve been recognized with awards two times because [of] my commitment and work with SWE in and outside my school/community. I’ve had interviews and offers thanks to them.

More directly connecting SWE events to obtaining jobs or internships, a white lesbian woman wrote, “Attending the SWE conference was the steppingstone to landing my first job.” At the same time, a white asexual queer aromantic biromantic cisgender woman said, “I have received numerous job/internship offers from the national SWE conference, which I would not have gotten otherwise.” An Asian bisexual cisgender woman “even got a job offer at the SWE conference.” A white queer woman also described acquiring an internship and job at an SWE event, “I have attended the national SWE conference the past 2 years and have gotten my internship last year and full-time job this year at the career fair there.” Connecting SWE as a women-focused networking organization to job opportunities, an American Indian and Asian bisexual and lesbian cisgender woman shared her experiences where women-positive firms provided opportunities at SWE events:

I have attended two SWE conferences that had job fairs with companies who value diversity, promoting

⁵Non-binary is used for participants selecting Gender Non-Binary/Genderqueer/Gender Non-conforming for readability.

the work and lives of women in engineering. I learned an immense amount.

These excerpts highlight the various processes through which SWE promotes its members' academics and careers. These include providing access to networks that are often the linchpin in students obtaining study groups, providing professional development, and providing connections to internships and jobs.

Race/ethnicity-focused organizations also provided academic and, more often, career resources ground in the development of networking opportunities, often with same-race engineers. Pointing out that she may not have had access to such resources without NSBE, a Black queer cisgender woman wrote, "NSBE provided guidance for my academic and professional journey and provided resources I wouldn't otherwise have access to." A Black, Latinx, and Chickasaw bisexual pansexual cisgender woman also wrote about academic resources, indicating that SHPE promoted her academic achievement by providing "a safe place to study." Similarly, a Black gay queer man highlighted the value of having a place to study: "NSBE has allowed me to meet more Black engineers and have a place to study." Emphasizing the specific professional development opportunities offered through NSBE, a Black and white bisexual cisgender woman wrote, "NSBE helped me with improving my resume, networking, and other professional stuff." A Black gay man underscored professional development, grounding its applicability in the support of a network of Black engineers, "NSBE has exposed me to career development opportunities and has helped me develop a professional network with other Black engineers which is important to me." Similarly, a Black gay man commented on the resources attuned to Black students, "NSBE has provided professional development resources specific to ethnic minorities." A Black gay man wrote that examples of Black engineers provided a role model into careers, "NSBE provided panels on other NSBE members and how those members found their current careers." Likewise, a Black lesbian cisgender woman wrote of its impact on her job prospects, "NSBE is the main reason I have continued engineering. They have given me multiple career opportunities." Of SHPE, a Latinx bisexual woman similarly noted, "SHPE is a great source of career advice and a place for job searching." A Black gay man wrote that SHPE also provided networking opportunities, "SHPE encouraged me to go to my first conference called Great Minds in STEM. Although I didn't find any job offers I did have the ability to network with different people." These comments show how race/ethnicity-focused organizations advance SGM students in STEM through academic and especially career resources and connections to engineers like themselves.

Barriers (and Bridges) to Organization Participation

While students described how identity-focused organizations cultivated their expressive and instrumental capital, they also mentioned that identity-focused organizations could include or exclude members with multiple minoritized statuses not within the stated purview of the organization. Specifically:

- Women-focused organizations could reproduce cultures of exclusion toward SGM students.
- Some organizations collaborated with other organizations to better serve diverse students.

Of women-focused organizations, a Muscogee and white bisexual woman wrote of the poor initial impression she had of SWE that made her never go to another meeting, "SWE felt hostile during the first meeting and I never went back." When asked about the influence of SWE on her progress, a white bisexual pansexual cisgender woman's response indicated that while she had a good chapter, some women-focused organization chapters were known to be problematic, "I do appreciate how inclusive the SWE local student chapter is. I am extremely disappointed how openly exclusionary other SWE chapters can be." A white genderqueer student concurred, rooting displeasure in an inability to feel comfortable in SWE due to identity conflict:

SWE has helped a lot and was a lot of the reason I received my internship. However, I struggled to feel comfortable there, because I am not out as genderqueer to any of my SWE peers and I am not a woman, and even though it is an inclusive environment, I feel dysphoric every time I attend any events.

Similarly, responding to the question of how SWE impacted their progress, an Asian queer and pansexual non-binary student wrote that they were unable to take advantage of SWE's resources because of the feeling of unwelcomeness SWE could cultivate among diverse students:

They have not. I have never felt welcome within that space as a non-binary, femme-presenting person. In the general meetings that I have attended, there was a lack of recognition of gender non-conforming and non-binary people, and a complete lack of sensitivity to the possibility of intersectional identities of their membership.

A white gay lesbian queer non-binary woman that self-describes as "mostly a girl but I'm also just chilling" also wrote about not fitting in at SWE, "I was briefly involved in SWE at the beginning of my first year, and it only solidified that I don't ever want to be a corporate sellout. I also don't associate with SWE anymore." A Black and white queer pansexual cisgender woman described SWE's lack of impact on her progress similarly and succinctly, locating the issue within the white women who comprise a numerical majority of the participants, as she said, "White women are problematic." An American Indian and white "but white-passing" lesbian queer non-binary trans woman indicated that while things began poorly, they seemed to be looking up in her SWE chapter:

Society of Women Engineers has been bittersweet; when I started many people were not educated on LGBTQ+ issues, but as I reach my last few semesters, I can see the change I initiated and encourage younger members to be out in order to increase visibility.

In contrast, an Asian and white demisexual cisgender woman's experience differed with many others' in that she found her SWE

chapter to be accepting and helpful in preparing her to negotiate her identities in the STEM workplace:

Society of Women Engineers has really made me feel like I can be out and open within my education and career further down the line. They help identify opportunities and put together things like workshops on how to discuss your identities with potential employers in professional settings.

These comments show how women-focused organizations can be unwelcoming to SGM students, particularly in their rendering invisible diversity.

Regarding race/ethnicity-focused organizations, issues of poor fit were infrequent. A Latinx asexual heterosexual agender woman wrote, “I was very committed to SHPE and held multiple officer positions. Now, I am no longer a member since I realized that I don’t really fit in in that group.” Likewise, a Black queer non-binary student described their experience saying:

I’ve met some people through NSBE, but ultimately, the chapter at my school is so cliquey that I struggled to find support through it. It has made me look to other people in my other organizations, such as my sorority, to help me as I pursue my degree.

These comments suggest that race/ethnicity-focused organizations’ fit issues, when they do occur, may be less related to students’ SGM identities.

Collaboration between organizations helped organizations serve students with multiple minoritized statuses. For instance, students mentioned that different organizations worked together for certain events to advance inclusion across women, racial/ethnic groups, and SGM groups. Collaborations spanned women-focused (SWE), race/ethnicity-focused (SHPE, NSBE), and SGM-focused (oSTEM) organizations. For example, a white bisexual multigender student wrote, “NSBE and SWE have done many collaborative activities,” and “SHPE and SWE have done a few collaborative activities.” Likewise, a white bisexual cisgender person noted the expressive social capital outcomes of such partnerships, “My SWE committee holds events with SHPE to further connections between minority student groups, it gives me a more diversified, inclusive perspective of STEM.” Comparably, a white lesbian woman shared, “SWE works closely with NSBE on several events to encourage equality in engineering.” In addition, an Asian queer pansexual non-binary student observed a partnership between SHPE and oSTEM in service of academic resources, writing, “SHPE and oSTEM have collaborated on a few Study Nights.” These excerpts speak to how some feelings of exclusion cultivated in some organizations might be mitigated through collaborative efforts.

DISCUSSION

In sum, there were similarities and differences in the expressive social capital provided by identity-focused organizations (i.e., women-, SGM-, and race/ethnicity-focused organizations). In general, identity-focused STEM organizations provided students expressive social capital in the form of social networks and

feelings of acceptance by being around others like themselves—they could be confident in their identity and ability to persist in their major at the same time (Voigt, 2020). These organizations provided role models, mentors, and more experienced students whose advice, encouragement, and example influenced students’ motivation to persist in STEM. This built a supportive homophilous community on campus for SGM students. This network of similar and/or accepting peers and others meant that students did not have to experience challenges alone, especially challenges they faced related to others’ perceptions of their identities, and their network offered sources of encouragement to keep going during difficult times. This also meant that students did not necessarily need to expend extra effort to cultivate relationships with other SGM students outside of STEM, who might be less able to provide advice germane to STEM (Campbell-Montalvo et al., 2022b).

Sexual and gender minority-focused organizations particularly helped students negotiate and better understand their own identities and, within the unwelcoming STEM climate, how their SGM identities could co-exist with a STEM identity (Voigt, 2020). The students were also able to facilitate and participate in conversations regarding LGBTQIA+ issues that they might otherwise not have had to chance to participate in elsewhere, especially in STEM settings. The value of this aligns with work by Friedensen et al. (2021) which identified a tension in SGM STEM students’ persistence in which they had to separate their SGM and science identities to persevere and looked toward a STEM career with eyes on how they would survive it. Our findings underscoring the value of oSTEM in cultivating a connection between SGM and STEM identities replicate previous work that found “[in comparison to other Queer clubs,] oSTEM, which seeks to foster this connection between STEM and Queer identity, was more well received and helpful in supporting a sense of belonging in STEM” (Voigt, 2020, p. 262).

Women- and race/ethnicity-focused organizations provided students safe spaces and exposure to other people like themselves who were excelling in STEM. For participants of SWE, it allowed them to escape the “dudebro” culture of engineering (Fisher and Waldrip, 1999; Seymour and Hewitt, 1999; Toynton, 2007; Antecol et al., 2008; Grunert and Bodner, 2011; Mattheis et al., 2019; Miller et al., 2020; Voigt and Reinholz, 2020; Palmer et al., 2021), and its legacy was also a motivating factor in continuing in STEM. For NSBE, seeing other Black engineers motivated students by increasing their confidence. Our findings here are consistent with the research conducted by McGee and Martin (2011), Campbell-Montalvo et al. (2021, 2022a,b), and Smith et al. (2021) which emphasized the particularly negative climate Black students face in STEM and how advice from others, including those in NSBE, helped students deal with stereotype threat and gain confidence by being around other Black engineers. The present study extends this previous work by showing that Black SGM students are able to access the same expressive capital open to the general population of Black engineering students. This is particularly important as Skvoretz et al. (2020) showed that Black students may enter their engineering program with less social capital than other groups, and SGM students face added burdens in accessing social capital in STEM spaces (Voigt, 2020;

Haverkamp, 2021; Campbell-Montalvo et al., 2022b). In addition, students in all identity-focused organizations talked about the feelings of motivation and satisfaction they got from welcoming students like themselves into the discipline; helping others helped them to persist.

The various social positioning of the groups of focus in these organizations as well as the larger social and historical context informs the ways participants reconciled their identities and arrived at particular identity outcomes from the expressive social capital provided by organizations. For instance, SGM identity needs, particularly for gender minority students, may comprise a more pressing need than their STEM needs (Kersey and Voigt, 2020; Campbell-Montalvo et al., 2022b). Accordingly, SWE's earlier inception date (1950) and white women being a main beneficiary of affirmative action policies (Crenshaw, 2006), both likely play into the proud history of SWE that motivates its members to persist, at the same time likely feeding into some of its members being close-minded about inclusive identities among would-be SWE members. This replicates previous research by Haverkamp (2021) in which SWE was not always welcoming to TGNC students (see also Kersey and Voigt, 2020).

The crucial source of identity confirmation from NSBE (established in 1975) to Black students may be influenced by the reality that Black students remain more excluded in STEM in comparison to their makeup of the U.S. population, in comparison to women's representation in STEM. For example, in 2018 nearly 4% of engineering undergraduate degrees were awarded to Black/African American students (~13% of the U.S. population), while nearly 22% were awarded to women (~51% of the population) (Roy, 2018). Thus, these social realities provide the setting in which a gathering of Black engineers profoundly motivates Black students through the provision of role models and excellence (Smith et al., 2021; Campbell-Montalvo et al., 2022a). Thus, NSBE, as a source of Black engineers to surround oneself with, is an oasis in the desert of U.S. and STEM disciplinary culture where the intelligence, personhood, and respectability of Black students in STEM (and Black people more broadly) is suspect (Steele and Aronson, 1995; Massey and Fischer, 2005; McGee and Martin, 2011; Beasley and Fischer, 2012; Gregory, 2015, 2016).

Participation in identity-focused organizations also provided SGM students access to instrumental social capital, particularly that related to academic and career support. Students were able to form study groups and gained access to career fairs, professional networking, and jobs and internships. Students were also exposed to settings or scenarios related to their anticipated career path or introduced to more specialized aspects of their anticipated career, offering anticipatory socialization in the area of employment.

However, within identity-focused organizations, SGM-focused organizations were less written about by students in terms of the instrumental social capital they provided. The details and various mechanisms that participants provided regarding how SWE and NSBE helped them in their academic and career suggests that these organizations have established robust mechanisms to increase students' instrumental social capital as part of the fabric of how the organizations operate. The comparable lack of instrumental social capital provided

by oSTEM could potentially be explained in part by it being a relatively new organization, having been founded in 2005. Still, this does raise questions about how well SGM students' instrumental social capital needs are being met.

However, in comparison to instrumental social capital needs, perhaps SGM-students' more imminent needs relate to negotiating their SGM identities with their STEM goals and identity, specifically increasing students' seeking of expressive social capital. Indeed, STEM students' SGM identities are "central to their higher education experiences" (Linley et al., 2018, p. 1). Yet, supporting the development of such identity-related expressive social capital could be an ideal point of departure for later instrumental social capital acquisition, in line with Fisher (2013). Importantly, the validity of taking this point of departure likely differs within SGM groups; for example, in Kersey and Voigt's (2020) research, and in the present study finding gender minority students fit in less, students "who were more gender-non-conforming felt a greater need for community with other queer people" (p. 1). In the end, the need to increase oSTEM's capacity to support instrumental social capital identified in the present study is supported by previous research that found that "Queer-spectrum students conveyed the greatest sense of belonging in STEM when engaged with resources that supported academic and social integration" (Voigt, 2020, p. 262).

Unfortunately, women-focused organizations were unwelcoming to many SGM students, particularly due to ideologies members exercised against those who were non-binary. Leaders and members in some organizations may feel that SGM students and their needs "don't speak to" the interests of the organizations' goals, reproducing the false notion that STEM is apolitical and that all that matters are one's skills as a scientist (McGee, 2020; Friedensen et al., 2021). This matches the broader STEM culture in which "heteronormative assumptions frequently silence conversations about gender and sexuality in STEM" which result "in complicated negotiations of self for Queer professionals" (Mattheis et al., 2019, p. 22).

CONCLUSION

Identity-focused professional STEM organizations are an important source of participatory social capital for SGM students, social capital that SGM students may not receive from other STEM sources, including family or faculty (Campbell-Montalvo et al., 2022b). Identity-focused organizations help SGM students persist in STEM by promoting their accumulation of expressive and instrumental social capital that specifically aids SGM students in managing their fit in STEM. Given the less robust identification of instrumental social capital provided by SGM-focused societies, SGM-focused organizations may want to evaluate the instrumental social capital offerings they have and consider expanding them if appropriate. Given the identification of barriers faced by SGM students in participating in women-focused organizations, these organizations have work to do when it comes to maximizing the capital received by their

participants and ensuring that members with multiple identities are included in order to promote STEM persistence.

Students described instances when organizations engaged in collaborations to promote instrumental and expressive social capital gains across a range of students, providing a glimpse into a more inclusive STEM future that might be achieved by wielding the power of partnerships among organizations. Such an approach could be particularly helpful in serving students with multiple minoritized identities whom this and other research shows are often excluded from accessing resources in women-focused organizations. Collaboration across organizations to support structural change, coupled with efforts to educate non-SGM and other majority people in STEM to be accepting, could be a promising strategy for enacting change to improve how SGM and other minority students are treated and thus experience STEM. Specifically, adjustments in the mental models of advisors and members of organizations, particularly those of advisors and members with majority identities, along with changes advancing practices and policies conducive to SGM student success through a range of expressive and instrumental capital and mechanisms could be promising (Campbell-Montalvo et al., 2020, 2022c; Kang, 2021; Leibnitz et al., 2021; Peters et al., 2021). These additional efforts are notable, especially given that most interventions only focus on helping students survive rather than on improving the STEM climate they experience. Changes in how organizations operate could have ramifications for diversity in STEM professions writ large. Future work should seek to further uncover how SGM students are served by a range of organizations including those not identity-focused, and how interventions in how organizations operate, such as those mentioned here, affect how students experience and are served by the organizations and persist in STEM.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because this data contains sensitive participant information.

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Requests to access the datasets should be directed to RC-M, rebecca.campbell@uconn.edu.

ETHICS STATEMENT

This study involving human subjects was reviewed and approved by University of Connecticut Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CS, MH, and MM were the PI team for the grant that funded this research. CS, MH, MM, and RC-M conducted interviews informing survey creation. CS, MH, MM, RC-M, JS, HW, and EP designed the survey together. HW calculated descriptive statistics from the results. HC with the guidance of RC-M, led the analysis of the qualitative data, including coding and thematic grouping, and drafted the findings section. RC-M drafted the other sections of the manuscript. All authors participated in meetings to discuss project approach, including data analysis and wrote up, review and editing of the final piece.

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The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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