



Amplifying Voices: Investigating a Cross-Institutional, Mutual Mentoring Program for URM Women in STEM

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Abstract

Underrepresented minority women in STEM comprise the faculty group most likely to leave academia. To address this issue we instituted a program called “Amplifying Voices,” a virtual, mutual mentoring program linking four groups of six women across 20 institutions. We facilitated bi-weekly Zoom meetings for two years and evaluated the effectiveness of the program. Participants reported reduced isolation, increased confidence, and enhanced self-efficacy. The groups were considered most successful when comprised of women who had similar career goals, but different perspectives, experiences, academic ranks and institutional affiliations. To inform future mentoring efforts, we identified issues and strategies frequently discussed in meetings.

Keywords Underrepresented minority · URM · Women · Mentoring · STEM

The U.S. science, technology, engineering and mathematics (STEM) workforce is challenged by problems of increasing complexity that can best be addressed by a diverse cadre of

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scientists and engineers. A major obstacle to diversifying the STEM workforce is the shortage of women, particularly underrepresented minority (URM) women (Black/African American, non-White Hispanic, Native American, Alaskan and Pacific Islanders) in academia. URM women make up nearly 18% of the population (United States Census Bureau, 2017), but only 3.0% of the science and engineering tenure-track faculty members in 4-year colleges and universities (National Science Foundation, 2017). The severe shortage of URM women in academia is a concern because by 2060 people from groups currently in the minority are projected to comprise nearly 50% of the population (Colby & Ortman, 2015).

Background and the Importance of Mentoring

Historically the relatively small number of URM women who earned STEM doctoral degrees largely explained the low numbers in the professoriate. However, the shortage of URM Ph.D.s no longer seems to be the main limiting factor (Myers & Turner, 2004). Rather, evidence suggests that academic careers are not an attractive option for URM women. Even in biomedical graduate programs where they are most highly represented, URM women students are less likely than White men and women or URM men to be interested in an academic career (Gibbs Jr, McGready, Bennett, & Griffin, 2014). The problem is difficult to address because only 2% of full professors in STEM are URM women (National Science Foundation, 2017), so there are few role models for URM junior women faculty. In addition, URM STEM women faculty members are often “the only” in a department or college. This situation is uncomfortable for them because they often endure both sexual and racial stereotyping, a type of “double bind” (Malcom, Hall, & Brown, 1976). Thus, it is not surprising that feelings of isolation may play a role in the decision of URM women to leave academia at greater rates than other groups (Hurtado & Figueroa, 2013).

Over the last two decades, many academic institutions have conducted climate surveys of STEM disciplines to increase awareness of discrimination and racism. There is also a growing call for more inclusive hiring practices (Martinez-Acosta & Favero, 2018), but less attention has been paid to increasing the retention and promotion of URM faculty members (Whittaker and Montgomery, 2014; Whittaker et al., 2015). Mentoring is the most commonly cited intervention to help faculty members achieve success in higher education, and it is perceived to be especially important for faculty members from underrepresented groups (Martinez, Boucaud, Casadevall, & August, 2018). Unfortunately, compared with other groups, URM faculty members may be less likely to receive effective mentoring from senior colleagues (Zambrana et al., 2015). In addition, formal mentoring programs instituted to address this issue often focus mostly on research-related skill development accomplished through workshops, curricula, and other “training” activities (Buchwald & Dick, 2011; Bussey-Jones et al., 2006; Daley, Broyles, Rivera, & Reznik, 2009; Daley, Wingard, & Reznik, 2006; Johnson et al., 1998; Johnson et al., 1999; Kosoko-Lasaki et al., 2006; Lewellen-Williams et al., 2006; Rabionet, Santiago, & Zorrilla, 2009; Rust et al., 2006; Viets et al., 2009; Yager, Waitzkin, Parker, & Duran, 2007). In many of these programs, senior faculty members serve as supervisors to help develop skills and networks for attaining tenure and promotion; but they generally do not act as providers of psychosocial support (Bozeman & Feeney, 2007; Zambrana et al., 2015), the other primary goal of mentoring (Kram, 1983, 1985). This may be why researchers (Beech et al., 2013; Sambunjak, Straus, amp; Marusic, 2006) failed to show a strong relationship between participation in formal mentoring programs and academic success. More informal forms of mentoring and peer-mentoring aimed at identity confirmation, acceptance, role-modeling, and friendship may provide a remedy (Kram, 1985; Noe, 1988; Sorcinelli & Yun, 2007).

Psychosocial support may be particularly important for the success of URM women in STEM because they face unique challenges associated with the double bind of being both women and minority (Eagan & Garvey, 2015; Gutierrez, Flores Niemann, Gonzalez, & Harris, 2012; Hess, Gault, & Youngmin, 2013; Johnsrud & Rosser, 2002; Lallensack, 2017; Malcom et al., 1976; Ong, Wright, Espinosa, & Orfield, 2011). However, it is often difficult for URM STEM women faculty to find mentors in their institutions who have an understanding of the cultural perspectives and unique needs of various minority groups (Lewellen-Williams et al., 2006). It is even more difficult to find understanding and empathetic mentors who also share research interests, values, and life experiences—commonalities that facilitate good mentoring relationships (Berk, Berg, Mortimer, Walton-Moss, & Yeo, 2005; Redmond, 1990; Sims-Boykin et al., 2003). Although women who participate predominately in same-sex networks may be further marginalized (Mickey, 2018–2019), Anderson and colleagues (Anderson et al., 2004) found that a network of female colleagues can provide important support and information. Such support may positively impact retention in the STEM faculty where URM women often deal with harassment, isolation, and implicit bias. For example, in one study, 40% of URM women in astronomy and planetary sciences felt unsafe due to the high incidence of harassment and even assault that they experienced in the workplace (Clancy, Lee, Rodgers, & Richey, 2017). Clancy and colleagues found that URM women in this situation may skip meetings, classes, fieldwork, or professional events, thus hampering their career advancement. Consistent with these observations, Norman and colleagues found that women of color in astronomy and astrophysics had difficulty developing networks and collaborations, achieving insider status, and finding effective mentoring (Norman et al., 2013). In addition, while most faculty members experience stress in academia, the stress caused by subtle discrimination negatively impacts the productivity of women of color more severely than White women (Eagan & Garvey, 2015). This finding may help explain why URM women are more likely to leave the professoriate before reaching the rank of full professor than URM male and White counterparts (Hurtado & Figueroa, 2013).

In view of these obstacles to career development, what may be lacking in institutional support systems for URM women faculty is *empathetic* mentoring. This type of mentoring is best provided by colleagues who understand issues associated with intersectional racial and gender stereotypes and who view this intersectionality as important for the advancement of science (Mack, Taylor, Cantor, & McDermott, 2014). However, empathetic mentoring relationships may be difficult to establish when mentor and mentee are in the same institution. In this article we describe a new model for providing empathetic mentoring across institutions using virtual technology.

The Amplifying Voices Project

Purpose and Model

The “Every Other Thursday” model of mutual mentoring has been shown to provide effective empathetic mentoring for both junior and senior women when participants can meet face-to-face (Daniell, 2006; Hardy & Thompson, 2017). In this study our goal was to determine the feasibility and effectiveness of adapting the mutual mentoring model to a virtual format linking URM women STEM faculty across multiple institutions. We also sought to amplify the voices of URM women by identifying and disseminating discussion themes and group-generated solutions to problems they encountered.

Our two-year project relied entirely on virtual technology to connect URM women faculty in STEM disciplines across different types of institutions. Participants were recruited in 2016

through a long-standing collaboration among 15 partners in the Northeast Alliance for Graduate Education and the Professoriate (NEAGEP),¹ an alliance established with funding from the National Science Foundation to diversify STEM Ph.D. programs and the professoriate. We used the mentoring model described in *Every other Thursday: Stories and strategies from successful women scientists* (Daniell, 2006). The model is based on a theory of self-empowerment and group problem-solving that has been highly successful in a university setting (Hardy & Thompson, 2017). In this article we describe the results of multi-pronged research evaluating whether the model could be successfully adapted to a virtual, multi-institutional environment. We also describe our efforts to “amplify the voices” of participants by reporting the challenges they encountered and the adaptive strategies they used to address the challenges. We anticipate that this information could be the basis for future workshops and interventions.

Establishing Mutual Mentoring Groups

The Institutional Review Board of the University of Massachusetts Amherst evaluated the involvement of human subjects and deemed the project exempt from further review. We distributed informational material (contact S. L. Petersen for more information) to core coordinators in NEAGEP institutions and to contacts at local colleges. The materials stated that anyone interested in promoting the inclusion and success of URM women in the STEM faculty was invited to participate. An interactional webinar explained the mutual mentoring model including the ground rules of respect, confidentiality, commitment, the nature of the groups, and the evaluation process. We then divided those who wanted to participate (all women) into four groups of five to seven women from similar disciplines, but different institutions. The groups included 16 African Americans, one Asian, five Hispanics or Latinas, one American Indian, and one White (the project was open to anyone interested in supporting URM women in STEM). There were 16 assistant, five associate, and three full professors. We used Zoom teleconferencing software for all orientations, presentations, mentoring sessions, and evaluation sessions.

Each participant received a copy of *Every other Thursday: Stories and strategies from successful women scientists* (Daniell, 2006) to supplement the informational webinars. The Project Coordinator participated in the initial meeting of each group to facilitate introductions and remind participants of the format and goal of the meetings. Subsequently, the Coordinator emailed reminders of scheduled meetings, but did not attend. To ensure that all participants became invested in the group, one person in each group was designated as the facilitator for a particular meeting, a role that was rotated among participants. This strategy minimized the possibility of hierarchical obstacles such as academic rank or home institutions interfering with freely sharing struggles. Each 60- to 90-minutes bi-weekly meeting used the prescribed problem-solving format designed to prevent meetings from becoming “gripe sessions.” A strategy for allotting time was described so that each participant could get input from others in the group to help her devise a plan of action. After each meeting the Project Coordinator sent each facilitator a link to an on-line Facilitator Survey.

¹ NEAGEP institutions include Bennett College; Boston University; Jackson State University; Lincoln University; Medgar Evers College; Massachusetts Institute of Technology; Pennsylvania State University; Rutgers the State University of New Jersey; and the Universities of Connecticut, Maine, Massachusetts, New Hampshire, Puerto Rico Mayaguez, Rhode Island, and Vermont.

Evaluative Research Tools

We addressed the challenge of having a relatively small sample size by using multiple qualitative and quantitative data collection techniques. The use of these multiple methods and the triangulation of data from various sources allowed data verification and helped to ensure the validity and the reliability of the findings. All surveys were conducted online using Survey Monkey®.

We administered a pre-survey anonymously before assigning participants to a mutual mentoring group. The survey assessed participants' views on their level of support prior to the mutual mentoring project. We administered a post-survey 14 months after the first group started in order to assess changes regarding level of support and effectiveness of the mutual mentoring process. Fourteen of the 24 participants (58%) completed the post-survey. We matched pre- and post-intervention surveys using IP addresses and analyzed data from those participants who completed both the pre- and post-surveys. The pre- and post-intervention surveys contained the same eight questions and a space for comments. We asked participants to indicate which of the five answers on the Likert Scale most closely matched their level of agreement (strongly disagree, disagree, undecided, agree or strongly agree). Questions probed whether participants had: 1) a network of supportive colleagues, 2) a peer group that understands issues people from diverse backgrounds face in academia, 3) a peer group that understands the issues women face in academia, 4) someone to talk to about how to progress in academia, 5) the feeling that they are empowered to handle conflicts arising in their work, 6) knowledge of how to negotiate for what they need at work, 7) feelings of isolation in work/research, and 8) feelings of isolation at their home institutions. In addition, the post-survey included questions about impact, the mutual mentoring process, and project functioning; and it also provided an opportunity for open-ended responses.

We used SPSS statistical software to run the Wilcoxon signed-rank test comparing the number of women whose agreement with statements on the pre- and post-surveys increased, decreased, or remained unchanged after the Amplifying Voices intervention. The change between pre- and post-surveys was considered statistically significant if the asymptotic significance (two-tailed) was $p < 0.05$.

To obtain in-depth data about the impact of the mutual mentoring on individuals we conducted a participant focus group and also asked meeting facilitators to fill out a brief on-line Facilitator Survey. The one-hour focus group was conducted by teleconference eleven months after the first group began. Two members from each group were chosen at random. With one absent, there were seven participants: four assistant, two associate, and one full professor. The participants were from different institutions and included five African American, one Native American, and one White faculty member. Participants were asked about their overall experience in the group, their experience using a virtual format, the topics discussed, the impact of the group, and their thoughts about the sustainability of the model. With participants' consent the focus group session was recorded. Analysis of qualitative data followed the steps described by Merriam (Merriam, 2009) to code data and develop themes and patterns as they emerged. Transcripts were open-coded, and six topics emerged (see Findings below). Each topic area was expanded and analyzed separately using the same technique.

We gathered additional qualitative data from Facilitator Surveys. After each meeting the rotating group facilitator completed a 6-question, anonymous, on-line questionnaire that asked them about the following: 1) the number of participants in attendance, 2) the overall themes

discussed in the meeting, 3) issues discussed during the meeting, 4) proposed solutions to issues discussed, 5) whether the meeting was helpful/enjoyable, and 6) if there were challenges or concerns. Responses were downloaded onto a spreadsheet and tabulated to allow comparisons across meetings and groups. We used content analysis techniques described by Merriam (Merriam, 2009) to analyze the data. We conducted the first analysis of group themes 11 months after the project was initiated and a second analysis six months later. Finally, we separated themes by topic and then calculated the frequency with which topics were mentioned. Within each of the topic areas participants discussed specific issues, and facilitators summarized the suggestions for potential solutions to these issues. We used the methods cited above (Merriam, 2009) to determine the type and frequency of solutions that were proposed during the group meetings.

Findings

In the presentation of our findings below, we provide representative comments when opinions were similar among participants. When a range of responses was received, we note differences in the opinions of participants.

Pre- and Post-Participation Surveys

Figure 1 shows the percentage of women whose responses changed (increased agreement or decreased agreement) or remained the same for each of the 8 survey questions. The changes were predominantly in the direction expected for a positive outcome (increased agreement for questions 1–6 and decreased agreement for questions 7 and 8). Interestingly, we found no significant changes in feelings of participants about networks of supportive colleagues and someone with whom they could talk about how to progress in academia. They also reported no change in feelings of isolation regarding their work/research. What did change was the sense that participants had a peer group that understands the issues that women and persons from diverse backgrounds face in academia. In addition, participants reported decreased feelings of isolation at their home institutions. One participant explained,

The difference here is that where I am, I really don't have access to very many other academics of color, women of color, and that for me is what is completely different about this experience. It is very valuable to me.

Results of the post-survey showed that participants generally agreed that the components of the mutual mentoring model, as well as the way it was instituted and supported, were effective. Eighty-six percent agreed or strongly agreed that the format met mentoring needs and provided an effective platform for discussing challenges faced in their institutions; 92% indicated that it was also a good place for discussing solutions to those challenges. Importantly, 93% agreed or strongly agreed that the virtual environment was an effective way to conduct a mentoring group. As one participant said, "Sometimes you need a shoulder to lean on, even if it's virtual."

In the post-survey we also probed factors that members ranked as most important for the success of the groups. Survey responses suggest that success of the group was fostered by having members with diverse perspectives and from different academic ranks and different institutions. Written comments indicated that having different perspectives provided new views on issues, created situations for thinking out of the box, and increased awareness of

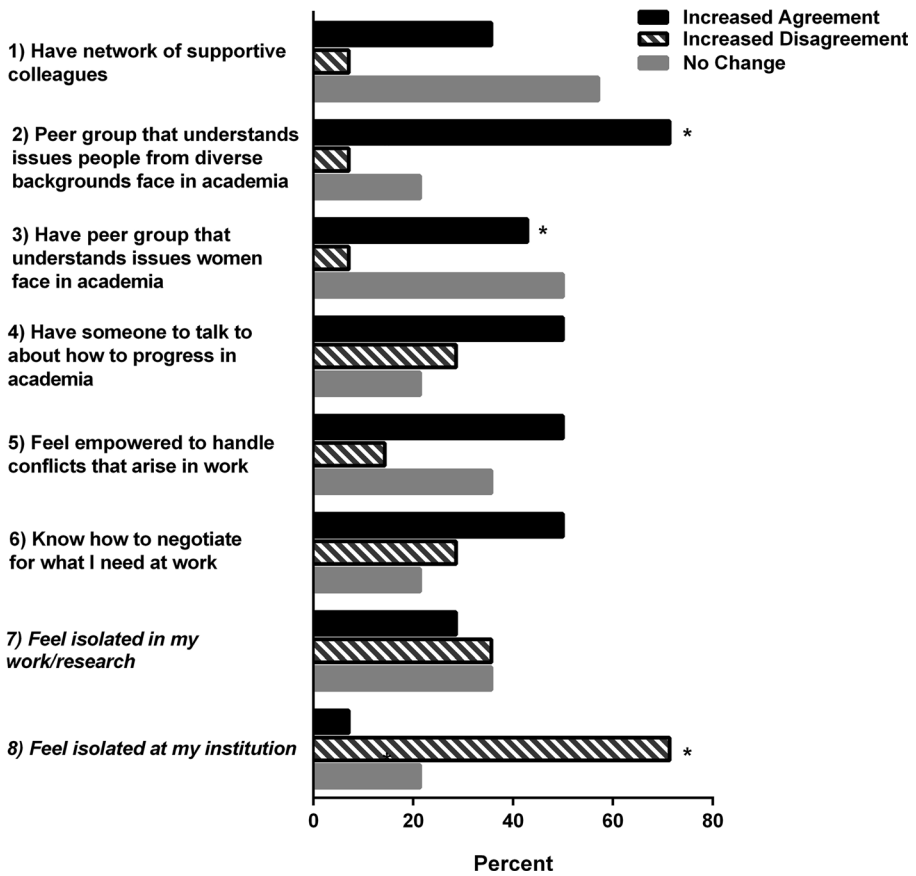


Fig. 1 Pre- and post-survey ratings about feelings of support and isolation among participants. Gray bars represent level of agreement before participating in the project and black bars the level of agreement after participating in the groups for 15 months. (1.0=Strongly disagree, 2.0=Disagree, 3=Undecided, 4=Agree and 5=Strongly agree)

specific issues for members who had not had the same experiences. Having groups with members at different academic ranks was viewed as important for sharing experiences and as a way of preventing or repeating the mistakes of others. In addition, junior faculty members noted that support and advice from more advanced women were valuable for helping them prepare for promotion. Respondents indicated that having members from different institutions avoided internal conflicts, provided confidentiality, allowed members to be more open, and helped to see the challenges at other institutions and how they were addressed. As noted in one post-survey comment,

I now have a group of individuals I can be honest and open with about problems and conflicts in my department and institution without worrying about these individuals running to the chair of my department or talking to other faculty about my concerns or comments.

Another benefit of the on-line multi-institution model was that best practices could be disseminated across institutions.

Post-participation surveys also indicated that groups comprised primarily of underrepresented racial/ethnic groups were desirable. Participants indicated that all-URM groups created an environment wherein people understood stereotype threat and implicit bias without having to educate colleagues about these issues. In addition, the groups were seen as an opportunity to interact with other URM academics that was not available at home institutions. Finally, the group was viewed as a safe environment in which to discuss issues experienced by underrepresented groups. As one person said, “I feel like I have a community of underrepresented colleagues to interact with (which I feel is already built-in for majority groups).”

Most respondents indicated a preference for groups of all women and groups which had similar concerns and goals and, to a lesser extent, similar scientific backgrounds. All-women groups were seen as facilitating open discussions of both implicit and explicit challenges faced by women in academia. They indicated that male faculty members would not have the same challenges and that having males in the group would bring up gender dynamics and potentially silence some members. However, a few respondents thought that males might provide a different perspective and that it would be an opportunity for better understanding. Similar scientific and research backgrounds were also considered important for group membership because of common funding issues, barriers, goals and stresses, as well as possibly establishing new collaborations.

There were few suggestions for program improvement, but some respondents thought an annual in-person meeting would benefit group cohesion and sustainability; however, they acknowledged the difficulty in facilitating such meetings when women were from different fields and regions.

Focus Group Findings

In line with the post-participation surveys, focus group participants indicated that the virtual format and the technology worked well and that they got to know each other and to become champions for each other. One respondent summed up the experience as follows:

I think that, truth be told, I was not necessarily completely sold on virtual meetings before, and I thought it would be very difficult to actually find community online in a virtual sense. I have to say that I think I really have found that.

Focus group members described meetings as particularly useful for dealing with feelings of self-doubt and noted that the group facilitated confidence-building, an important factor in academic success. One person reflected “...what is most useful is that sense of confidence that I think the group has given me in my own abilities.” Another noted, “It provided a forum for supporting and learning from a group member going through the tenure process..., and it has been an incredible learning experience.”

Members emphasized the positive impact within behavioral, emotional and cognitive domains. One noted,

There are times now when I have to step away from the situation, and it is not time for [the] group to meet yet, but I think about the things that we talked about in group, and it forces me to do something different than I would have necessarily come up with before group.

Another stated,

It has been incredibly useful in mostly troubleshooting problems, but there's also a sort of a notion of accountability. So basically, because I know that these meetings are happening every two weeks, I want to be able to report that progress has been made every two weeks—that gives me some motivation actually to keep me on track.

In addition to behavioral changes, focus group members indicated changes in the way they approach situations and problem solving. One person indicated that, when she encounters problems and considers solutions, there have been times when she says to herself, “let me think about what group would say about this.” Another noted that she had gained “a set of psychological skills to approach my work that I think I may not necessarily have had before.”

Lastly, emotional support seems to be a critical component of the mentoring groups. Group members derived a sense of community not available to them elsewhere, reported boosts in confidence, and noted it was good to be in an environment where they were not judged. One participant said, “We took a break over the Christmas holiday vacation, and I have to say that, yes, I was very, very happy to resume. I felt that there was definitely something missing.”

In terms of meeting logistics, groups of five were seen as the most productive; and participants indicated that an outside coordinator was necessary to identify participants, match them in groups, and possibly intervene if a group was not doing well. Some participants indicated that adding a new member to a group with low participation rates may be helpful, while others preferred not to add members to an established group.

In line with post-participation survey results, focus group participants indicated that differences in institutional types and academic rank were not obstacles and may even have been strengths in the group structure. Comments reflective of this view were exemplified by one group member who said,

I find the diversity of career stages to be really interesting and helpful. So, we have people who are sort of just starting out as assistant professors, and we also have people who are sort of fairly senior....We have people who are at small liberal arts colleges, large R-1 institutions, we have people who are grant-funded (you know, solely grant funded), so that's been the great thing. [It is] really helpful for me to see how the different institutions actually approach these things.

Others noted that they never really talked about their disciplines, that conversations were more about their struggles. They found a certain liberation in knowing that others in the group were “not potential collaborators or associated with [their] work in any way.” However, one focus group participant thought that it might have been harder for her group to come together because they were at different career stages.

Comments in the focus group suggested that the type and format for discussions varied. One group indicated that they would come up with topics for the next session at the end of the meeting, while other groups chose topics at the start of each session as recommended in the Daniell (2006) book. Facilitators had roles varying from keeping conversations focused to having little influence because the group seemed to “flow naturally.” While the majority of comments about the groups were positive, one member indicated that she was part of a group that did not gel well and that members (including herself) often did not attend due to scheduling conflicts or travel. Her comments suggest that consistently reliable attendance among group members is an important factor in group success.

Facilitator Survey Findings

Results of the biweekly survey analysis mirrored those of post-participation surveys and the focus group. Overall, participants indicated that their groups worked because they understood each other's struggles; felt relieved to know that they were not alone in the challenges that they faced; and often came to new insights by sharing professional experiences, achievements, and challenges. Facilitators also commented that the supportive atmosphere empowered them and fostered a level of trust that is hard to find in other places in their everyday work. They felt they were able to come up with creative and doable solutions to serious problems and noted that this was a true peer mentoring opportunity. One facilitator summed up the experience in saying, "People shared about their lives, and we learned coping strategies from each other; we laughed a lot."

Only two challenges were reported on the biweekly post-meeting surveys. Facilitators indicated that it might be helpful to further encourage all participants to read the book provided. They felt that following the *Every other Thursday* process more closely could help ensure that everyone had sufficient time to talk. Some facilitators suggested that periods of low attendance made them worry about "group cohesion and sustainability" and thought that missing meetings "compromises the benefits to the group."

To obtain information regarding issues URM women faculty in STEM face, we analyzed the frequency of discussion topics mentioned in facilitator surveys (Fig. 2). Analysis included 29 meeting surveys during the first year and 28 near the end of the second. The main discussion topics remained consistent between analyses; listed in order of frequency mentioned, they were: 1) dealing with multiple demands and the stress of academic work, family, and personal life; 2) research and publication productivity; 3) importance of networking and collaboration; 4) managing the tenure process; 5) discrimination in the work place; 6) career development; 7) navigating political and institutional issues; and 8) student issues. All categories of topics increased in frequency between the first and second analysis, but discussion of political issues and discrimination increased

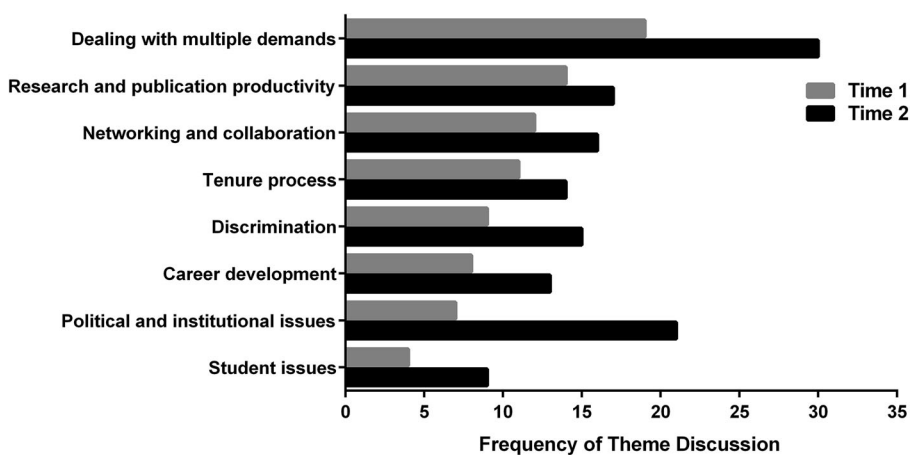


Fig. 2 Frequency of themes discussed in the four groups of participants. Bars represent the frequency with which each theme was mentioned on Facilitator Surveys after each meeting. Gray bars represent the results of Facilitator Survey analysis of 28 meetings in the first year (Time 1) and black bars depict data from analysis of 29 surveys gathered during the second year of the project (Time 2)

most dramatically. The increased number of comments overall may be due to increased comfort and identification with the group that participants expressed, as well as trust in group confidentiality. [We also note that the project spanned the 2016 election.] Specific issues discussed under each of these topics and potential solutions suggested by the groups can be found in the Appendix.

Discussion

Our findings demonstrate the feasibility and value of a novel, cross-institutional, mutual mentoring program conducted entirely through virtual technology. The virtual environment did not interfere with the formation of cohesive and mutually supportive groups of women in STEM disciplines. In fact, despite never meeting in person, groups became trusting and supportive environments wherein struggles could be discussed without fear of judgment, something many did not find in their home institutions. Consequently, the program was rated by participants as especially effective at decreasing the sense of isolation experienced by the URM STEM women faculty members. In addition, by openly sharing experiences, women expanded their repertoire of coping strategies, experienced increased self-confidence, and reported behavioral and cognitive changes in the ways they tackled challenges. By tracking self-reported topics discussed in each meeting, we identified a number of challenges faced by URM women in STEM disciplines that may inform institutional initiatives focused on diversifying the STEM professoriate. Overall, we found that the Amplifying Voices mutual mentoring program was a cost-effective way to provide empathetic mentoring that may not be available to URM women through institutional programs focused on career development. It seems likely that both types of mentoring are important for retention and advancement of URM women in STEM fields in academia. This idea builds on the work of Sorcinelli and Yun suggesting that mentoring for diversity may be best accomplished by non-hierarchical structures with multiple mentors to meet different needs of the mentees (Sorcinelli & Yun, 2007; Yun & Sorcinelli, 2009).

An important feature that differed between the Amplifying Voices groups and previous groups that used this model (Daniell, 2006; Hardy & Thompson, 2017) was that all but one of the participants were women from underrepresented racial/ethnic groups. Participants viewed this as one of the most important factors for the success of the mutual mentoring groups. They valued the opportunity to interact with other underrepresented academics and to have a safe environment in which to discuss issues experienced by minority faculty members. Similarly, women mentored by women peers in this program reported increased self-confidence and self-efficacy. These findings are consistent with evidence that shared identity in mentoring relationships for women engineering majors increased the likelihood of completing the major and aspiring to post-graduate careers, outcomes linked to an increased sense of belonging and self-efficacy (Dennehy & Dasgupta, 2017).

We were somewhat surprised to find that the women who joined the Amplifying Voices groups indicated that they had a network of supportive colleagues, a perception that did not change much after participation in the project. However, somewhat paradoxically, the same women indicated that they felt isolated and lacked a sense of belonging before joining the groups. Importantly, these feelings were reduced after participating in Amplifying Voices. Our findings are in line with the idea that mentoring has different functions categorized as career development and psychosocial support (Kram, 1983). Institutional mentoring programs for

URM STEM faculty are often designed to increase skills and visibility important for career development and attainment of tenure (Buchwald & Dick, 2011; Bussey-Jones et al., 2006; Daley et al., 2009; Daley et al., 2006; Johnson et al., 1998; Johnson et al., 1999; Kosoko-Lasaki et al., 2006; Lewellen-Williams et al., 2006; Rabionet et al., 2009; Rust et al., 2006; Viets et al., 2009; Yager et al., 2007). Unfortunately, mentors are rarely faculty members from underrepresented groups or women because most senior STEM faculty are White males. The Amplifying Voices model of mutual mentoring among women of color in STEM may provide key psychosocial support to supplement institutional programs focused on other skills important for achieving tenure and promotion.

Mentoring for career success and for meeting psychosocial needs has been described as having separable goals; but our research suggests that they are linked, at least for URM women. The comfort, acceptance, and affirmation women felt in the Amplifying Voices groups were accompanied by a reported increase in self-confidence and a sense of empowerment. As a result, many felt that they were better able to solve problems and advocate for themselves. In addition, they reported being better able to translate the insights they achieved in the group into behavioral changes that helped them overcome work conflicts and solve academic issues. Many also reported a greater sense of accountability that made them more likely to complete tasks. Thus, meeting psychosocial needs helped these women develop strategies for career success.

Conclusion

Our evaluative research confirmed that the virtual mutual mentoring model was an effective way of creating a cross-institutional community of personal support for URM women in STEM. Given the relatively low cost of program coordination and the capacity to network individuals across institutions with available technologies, we believe that the Amplifying Voices program is an attractive model for providing a mentoring community for URM women. Combining the empathetic psychosocial mentoring of the virtual Amplifying Voices program with career-focused mentoring at home institutions may be a more effective way of supporting URM women faculty members in STEM fields than either program alone. Implementing the Amplifying Voices nationally might, indeed, increase the retention and promotion of URM women and help reverse their current shortage in STEM academic departments.

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Appendix

Most frequently discussed topics in Amplifying Voices mutual mentoring sessions (listed in order of descending frequency)

- (1) Dealing with multiple demands and stress of academic work, family, and personal life

This category included such topics as balancing research and administrative responsibilities with personal life, time and task management, decision-making, and self-care (including

health, weight and exercise). Solutions focused on organizational strategies, specific self-care ideas, self-affirmation, and limit-setting.

(2) Research and publication productivity

This category included issues such as publishing, grant-writing strategies, research productivity, and gaining the support of one's department chair. Solutions in this category tended to be very concrete and included blocking out time in one's calendar, finding partnerships in nearby institutions, reaching out to senior and junior faculty for writing feedback, declining tasks that would not enhance one's academic portfolio, obtaining recommendations for specific grants to apply for, working on publications before grants, getting co-PIs with grant experience, using critical reviews to develop alternative strategies, and mapping out plans for effective use of time.

(3) Importance of networking and collaboration

This topic included discussions of building relationships in one's department and discipline, ways to engage colleagues, and the difficulties of entering male-dominated networks and scientific networks as minority women. Solutions discussed were strategies for reaching out to potential mentors, using existing contacts in academia and industry to expand one's network, using mentors and sabbaticals to find and establish collaborations, and finding opportunities with researchers with similar interests.

(4) Managing the tenure process

Topics centered on managing the process, navigating expectations of research vs. service, deciding when and if to extend the tenure clock for children, and dealing with tenure stress and negative reviews. Solutions included doing an internal audit of what one needs to achieve tenure, waiting to see what reviews were like before reacting, and managing one's responses to tenure reviews.

(5) Discrimination in the work place

Topics included dealing with chauvinism, microaggressions, negative comments, isolation at work, not being heard at meetings, racism and student incivility in the classroom, and aggressive or hostile competition in the work place. Solutions included seeking support from female colleagues in other departments and supportive deans, sharing resources to address poor support from faculty peers, practicing self-advocacy and self-compassion, avoiding conforming to the perceived cultural context, using theoretical frameworks to understand the situational dynamics, refraining from ruminating about colleagues' intentions when microaggressions occur so that you can thrive in the environment.

(6) Career development

Group members discussed topics such as making transitions within academia, dual-career couples, opportunities outside academia, interviewing, and fit within one's university.

Solutions included specific advice on job searches, how to solicit recommendations, and how to determine whether discontent with academia was a misfit with one's institution or discontent with the field.

(7) Navigating political and institutional issues

Issues included problems dealing with peer and departmental politics at work, tackling space issues, confronting the implications of national political changes on federal research funding, and the impact of the political climate on one's work life and classroom dynamics. Solutions discussed in this category included how to deal with the pressure of departmental politics, how to negotiate for space, and how to identify senior mentors or sponsors to help. Participants shared personal coping strategies for dealing with difficult times, especially for people of color. Open and transparent conversations were suggested as a strategy for establishing good working relationships. Also suggested was creating safe environments for a classroom culture that promotes critical thinking and evaluation of what is going on so that people do not feel bullied or personally attacked in class.

(8) Student issues

Discussions in this category were about mentoring students, teaching at under-resourced institutions, and dealing with new courses and student feedback. Solutions proposed included setting boundaries on one's time (engage students but do not take on their problems), not always needing to have the answer (particularly about diversity issues), developing successful teaching styles, and accessing teaching materials from archives or other faculty.

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