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**Supporting a Community of Women in STEM through the Navigation by Mentoring
and Peer Leadership Program**

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Abstract

The retention and persistence rates of females majoring in mathematics have been consistently lower than their male peers. The disparity in the rates of minority females graduating in mathematics at the baccalaureate level continues to be a national challenge. Through the support of the Tensor Foundation and Mathematical Association of America Women and Mathematics grant, the Navigation by Mentoring and Leadership (NML) program at the New York City College of Technology of the City University of New York was designed to address these major issues. The goal of eradicating gender disparities in Mathematics and other Science, Technology, Engineering, and Mathematics (STEM) areas can be assisted by creating a matrix of academic and social support structures for women. These structures include a multi-tiered mentoring program in which role-modeling and leadership skills are enhanced through the Peer-Led Team Learning curricular model.

Introduction

The disproportion of minorities and females graduating in the mathematical sciences and statistics has been well documented. According to the National Center for Science and Engineering Statistics (2010), approximately one-fifth of all the recipients are from underrepresented minority groups and less than one-tenth of the total recipients are underrepresented minority females.

The reasons for the low number of women in the mathematical sciences have been identified as a complex intersection of social forces. For example, Campbell et al. (2002) observed that prior studies by Sax (2008, 1994) suggest that “relatively low self-confidence in mathematics-related subjects strongly predicts a non-science and non-engineering major, while declining confidence during the early years of college often leads to a switch from science and engineering to other fields” (p. 14). Moreover, the low retention and persistence rates of college women in mathematics, science, and technology may also be due to the “self-beliefs that they hold about their capabilities” (Zeldin et al., 2008, p. 1036). Additionally, Single et al. (2000) noted that “Women enter undergraduate engineering and science programs with similar levels of motivation, ability, academic preparation, and support as their male counterparts” (p. 115), and they attribute the drop in academic self-confidence and self-esteem in the first year of college to “competitive and unwelcoming classroom environments” as well as being

“excluded too often from informal networking, mentoring relationships, and research opportunities” (p. 115). The study by Single et al. (2000) reports the effects of a proactive socialization program intended to form and strengthen peer ties between female mathematics majors as well as between female undergraduates and their faculty mentors in an urban, open-access, comprehensive college.

New York City College of Technology (City Tech) is an urban, open-access, comprehensive college. It is a designated Hispanic-serving institution, and it is at the threshold for designation as a Predominantly Black Institution. Over half of the students enrolled at City Tech are first generation college students (first in their families to attend college). The 16,000 plus student body come from a wide range of economic, ethnic, and cultural backgrounds.

The Navigation by Mentoring and Leadership (NML) Program

The goal of the NML program is to increase the representation, retention, and success of female Applied Mathematics students and others with a demonstrated commitment to eradicating gender disparities in Applied Mathematics and STEM disciplines. The combination of role modeling and leadership development through the Peer-Led Team Learning (PLTL) project provides the mentoring support structures for these women. Additional components of the program include support for conferences, organized field trips, research experience, and networking opportunities with mathematics and science faculty.

Students majoring in STEM, particularly women, who have succeeded in selected mathematics courses (MAT 1375: Precalculus and above) at City Tech are invited to apply for a Peer Leader position. Peer Leaders facilitate one-hour workshops per week in a designated mathematics course. Training for the Peer Leaders is two-fold: new peer leaders are enrolled in the MEDU 2901: Peer Leader Training in Mathematics course, and first-time and experienced peer leaders attend a weekly Leadership Seminar. Mentoring occurs during both junctures. Participants in the training course establish a relationship with the mathematics faculty who they are facilitating workshops for and with the learning specialist who is teaching the course. The Leadership Seminar is a multi-tiered mentoring model comprising faculty and new and experienced Peer Leaders. Seminar topics include: workforce and graduate school preparation; critical professional etiquettes (email, thank you, and dining); and issues concerning gender and cultural stereotyping.

Participants

Students majoring in Applied Mathematics, Chemical Technology, and several areas in the Engineering Technologies were invited to join the NML program, particularly women. Since the inception of the program in 2009, there were a total of 37 female participants in the NML program. Out of the total 37 participants, 28 (75.7%) were majoring in Applied Mathematics and nine (24.3%) were either in Chemical Technology or other Engineering Technologies (e.g., Computer Engineering). Approximately 75.7% (28) of the students were from underrepresented minority groups in STEM.

Findings

To evaluate the NML program, surveys were distributed and focus groups were conducted at the end of 2012 spring semester. Participants were given a Program Satisfaction survey, Mathematics Self-Efficacy survey (Bong, 2002), Mathematics Goal Orientation (Vandewalle, 1997). Participants rated mentoring through the Leadership Seminar, the PLTL leadership experience, and conference presentation/participation as being the most beneficial components of the NML

program. The program provided the female students with more confidence to persist in their majors. They also found the time they spent with women mathematics and science faculty during the networking events to be highly valuable, especially the information on the process of applying for, and the discussions of the culture of, graduate school. Table 1 summarizes the results of this survey. Overall, the NML members' mean responses to the seven program components were exceptionally favorable.

Table 1. Means of Responses on Helpfulness of NML Program Components

	Mean 1=not helpful and 5=very helpful (n=23)
1. Community of Women Mathematicians	4.6 (n=23)
2. Mentoring Program: Leadership Seminar	4.7 (n=18)
3. Peer-Led Team Leadership Opportunities	4.7 (n=18)
4. Networking Luncheon with Women Mathematics Faculty	4.3 (n=16)
5. Workshops (Personal Statement/Resume)	4.6 (n=23)
6. Research Opportunities	4.5 (n=11)
7. Conference Presentation and Participation	4.7 (n=18)

Students who were in the Peer Leadership component of the program responded positively to statements regarding their mathematics self-efficacy as indicated in Table 2. Many of the students were enrolled in high level mathematics courses which may have reflected their responses.

Table 2. Means of Responses to the Mathematics Self-Efficacy Survey

Mathematics Self-Efficacy Modified version of Motivated Strategies for Learning Questionnaire (Bong, 2002)	Mean 1=strongly disagree and 7=strongly agree (n=16)
1. I'm certain I can understand the ideas taught in my mathematics courses.	5.5
2. I expect to do very well in my mathematics classes.	5.5
3. I am sure I can do an excellent job on the problems and tasks assigned in the mathematics classes.	5.5
4. I know that I will be able to learn the material presented in the mathematics class.	5.5

The participants' responses regarding goal orientation have been more positive, as summarized in Table 3. They are willing to select challenging assignments, find opportunities to develop new skills and knowledge, and enjoy challenging and difficult tasks in learning new skills. In

contrast, they are less inclined to work in situations that require a high level of ability and talent, and they would avoid situations where they might perform poorly or appear incompetent.

Table 3. Means of Responses to the Goal Orientation Survey

Goal Orientation (Vandewalle, 1997)	Mean 1=strongly disagree and 7=strongly agree (n=16)
1. I am willing to select a challenging assignment that I can learn a lot from.	5.8
2. I often look for opportunities to develop new skills and knowledge.	5.8
3. I enjoy challenging and difficult tasks where I'll learn new skills.	5.8
4. I prefer to work in situations that require a high level of ability and talent.	5.5
5. I would avoid taking on a new task if there was a chance that I would appear rather incompetent to others.	5.9
6. I prefer to avoid situations where I might perform poorly.	5.9

Selected comments on the NML program from the participants included:

- As a peer leader in the NML program, this opportunity has helped me to improve my leadership skills through the Peer-Led Team Learning project. The NML program is like a big basket that contains many wonderful opportunities, such as training, workshops, and conferences for students. I enjoy being part of this program because I am allowed to mentor the new members, as well as benefit the exposure to many eye-opening opportunities. This is a great learning experience for me, both as a leader and as a student. – *Karmen T. Yu*
- The NML Project has inspired me to give my best, to keep learning, and to improve daily, while helping others succeed in a similar goal. I am thankful for having this opportunity to test my skills and leadership abilities and to be part of such a great program. – *Milica Jevtic*
- I truly appreciate the NML program, which gave me a great opportunity to develop my leadership skills. This fantastic experience provided me a chance to be creative especially when it came to helping my peers succeed. – *Subua Zeng*

Conclusions

The outcomes of the Navigation by Mentoring and Leadership program demonstrated the effects of a vibrant community where female Applied Mathematics students and others were nurtured and encouraged to succeed academically. Through the Peer-Led Team Learning Leadership program, participants have gained a newfound confidence to take on challenging and difficult mathematical tasks as well as a willingness to find new opportunities to develop their analytical and critical thinking skills. Although the sample size was small, the results from this program have demonstrated the benefits of a more welcoming institutional climate for women. By providing accessible pathways, a support system such as the Navigation by Mentoring and Leadership program

has the potential to positively impact student persistence and future academic success, particularly for females.

Note: The Navigation by Mentoring and Leadership program was awarded again for a third year (2012-2013).

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