2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #40340

Retention of Female Minority Students in Bachelor STEM Degree Programs: An Exploratory Study of Five Cohorts

Dr. Elizabeth Milonas, New York City College of Technology

Elizabeth Milonas is an Assistant Professor with the Department of Computer Systems at New York City College of Technology -City University of New York (CUNY). She currently teaches relational and non-relational database theory and practice and Data Science courses to undergraduates in the Computer Systems Major. Her research focuses on four key computer areas: Web: research on the mechanisms used to organize big data in search result pages of major search engines, Ethics: techniques for incorporating ethics in computer curriculum specifically in data science curriculum Programs/curricula: evaluating Data Science programs in the US and China and Retention: evaluating minority female retention in computer related degree programs.

Retention of Female Minority Students in Bachelor STEM Degree Programs: An Exploratory Study of Five Cohorts

1.0 Introduction

Female minority students are underrepresented in academic based undergraduate science, technology, engineering and mathematics (STEM) degree programs [1]. This group of students which is comprised of American Indian or Alaskan Native, Asian, black or African American, Hispanic/Latino, Native Hawaiian or Other Pacific Islander, faces unique challenges that can discourage them from continuing with a STEM degree including the lack of writing and degree readiness skills such as mathematical and computational thinking [2]. Minority female students are also faced with economic challenges and family commitments which can hinder or discourage them from continuing in a degree program [2]. In addition, minority females lack female role models in academics and industry. They are influenced by the stereotypical belief that white males dominate the computer field and that certain groups do not belong in this field [3]. These prejudices and stereotypes can be reinforced in the home, and as a result, many minority females are not encouraged or supported to pursue or to continue in STEM-related degree programs [1]. Furthermore, these students feel ill-prepared to apply and interview for jobs in their field [4]. They lack confidence in their ability to create effective resumes and cover letters [4] and experience anxiety when it comes to job interviews due to their perceived lack of interview skills [5]. The underrepresentation of these female minority students in undergraduate STEM degrees is evident in the bachelor STEM degree programs offered at New York City College of Technology (City Tech), a part of the City University of New York (CUNY). In the fall 2022 semester at City Tech, female minority STEM students represented 13% of the total freshman, full-time student population and 15% of the total freshman, full time STEM student population.

The goal of this exploratory research study is to examine retention data for freshman, full-time female and male minority students (American Indian or Alaskan Native, Asian, black or African American, Hispanic/Latino, Native Hawaiian or Other Pacific Islander) and freshman, full-time female and male non-minority students (white, non-Hispanic) in STEM bachelor degree programs offered at City Tech. To conduct this analysis, data was collected from five consecutive cohort years (2012-2016) which represent the years that students were admitted into the college. The research questions answered as a result of this analysis:

RQ1: Do female minority STEM students differ from male minority STEM students in terms of a) completing the bachelor STEM degree program within four years at City Tech, b) continuing enrollment in the bachelor STEM degree program at City Tech past the four year timeframe and, c) dropping or stop attending from bachelor STEM degree programs at City Tech before completing the degree?

RQ2: Do female and male minority STEM students differ from female and male non-minority STEM students in terms of a) completing the bachelor STEM degree program within four years at City Tech, b) continuing enrollment in the bachelor STEM degree program at City Tech past the four year timeframe and, c) dropping or stop attending from bachelor STEM degree programs at City Tech before completing the degree?

2.0 Literature Review

The advancements and progress achieved in the fields of Science, Technology, Engineering, and Math (STEM) heavily rely on the contributions and discoveries made by skilled and dedicated individuals who are trained in these disciplines [6]. However, despite comprising more than half of the world's population, women remain underrepresented in many of these STEM fields, particularly women from minority backgrounds [6]. This underrepresentation is prevalent at all levels of the STEM discipline including senior leadership positions [6].

Although there has been an increase in the number of women earning degrees in STEM in recent years, female minorities remain underrepresented in these degree programs [6], [7], [8]. Therefore, it is crucial to identify strategies to enhance recruitment and retention of female minorities in STEM programs [6]. Numerous research studies identified strategies that can be implemented in the undergraduate curriculum to enhance recruitment and retention. Two such strategies that have demonstrated success in retaining female minority students will be briefly outlined below and will be implemented in a future phase of this study.

Peer-Led Team Learning (PLTL)

Incorporating peer-led team learning (PLTL) into the undergraduate curriculum has been identified as an effective strategy for retention [6]. Peer-led team learning involves pairing a successful past student as a peer mentor with current students in the course, creating a "community of practice" that enhances female confidence [9], [10], [11], [12], [13], [14], [15], [16], [17]. Quantitative data has demonstrated a significant improvement in student performance when peer-led team learning was implemented into a course [9], [10], [11], [12], [13], [14], [15], [16], [17]. Research in Peer-Led Team Learning (PLTL) has shown that PLTL is effective in retaining under-represented students (female and minority students) in undergraduate computer science introductory classes [9], [10], [11], [12], [13], [14], [15], [16], [17]. In addition, incorporating PLTL in computer science curriculum increases participation and retention of under-represented groups specifically female students [9], [10], [11], [12], [13], [14], [15], [16], [17], [18]. Implementing PLTL increases a sense of community among students due to the consistent interaction with the same student leader and participants [18].

Role Models

Lockwood and Kunda (1997) define a role model as someone who has achieved what target individuals hope to achieve, is at a more advanced career stage and inspires the target individuals. Exposure to female STEM role models has been shown to be highly beneficial in increasing retention, particularly among female minority students [6]. Interacting with female role models in STEM fields fosters a sense of belonging [6] and encourages a vision of a future self in the STEM fields [19], [20]. Furthermore, female minority students who interact with accomplished women in STEM fields are more likely to believe that it is possible for them to achieve similar STEM positions and are encouraged to remain in STEM degree programs and complete their education [6], [21].

3.0 Method

3.1 Data Source

The data used in this analysis was obtained from the Assessment, Institutional Research and Effectiveness (AIRE) Office at City Tech. The AIRE Office provides student-related data to support grants, assessment/accreditation, and research.

The criteria used to gather the data for this analysis included data related to female and male minority STEM students and female and male non-minority STEM students who were first-time freshman, enrolled full time in a STEM bachelor degree program, and were in cohort years 2012 through 2016. Graduation and retention data were not available for cohorts after 2016 and therefore the cohort years 2012-2016 were chosen. The graduation and retention data analyzed are from four years after each cohort year. For example, if a student enrolled in 2012, their expected year of graduation would be 2016. This pattern applies to students who enrolled in 2012 through 2016. In addition to the above criteria, the following information was gathered:

- Data related to the size of each cohort (2012-2016)
- Data related to the completion of bachelor STEM degree programs within four years at City Tech
- Data related to the completion of bachelor STEM degree programs past the fourth year at City Tech
- Data related to the drop/stop attending from bachelor STEM degree programs at City Tech

At City Tech, students are classified as minority students if they are American Indian or Alaskan Native, Asian, Black or African American, Hispanic/Latino, Native Hawaiian or Other Pacific Islander. Students are classified as non-minority students if they are white, non-Hispanic. Bachelor STEM degree programs are located in the following departments: Architectural Technology, Biological Sciences, Career and Technology Teacher Education, Chemistry, Communication Design, Computer Engineering Technology, Computer Systems Technology, Constructing Management and Civil Engineering Technology, Electrical and Telecommunication Engineering Technology, Entertainment Technology, Environmental Control Technology, Mathematics, Mechanical Engineering Technology and Physics

3.2 Datasets

For the five cohort years examined (2012-2016), there were a total of 928 female minority STEM students, 1500 male minority STEM students, and 214 female and male non-minority STEM students who met the data analysis criteria listed in section 3.1. Female and male non-minority data were combined as the female non-minority population was too small to analyze on its own. Table 1 displays the number and percentage of these students per cohort year.

Cohorts and Number of Female and Male Minority and Non-Minority STEM Students						
	Female Minority	Male Minority	Female & Male Non-Minority	Female Minority	Male Minority	Female & Male Non-Minority
Cohort Year	**Number**	**Number**	**Number**	**Percentage**	**Percentage**	**Percentage**
2012	95	156	18	35%	58%	7%
2013	148	258	43	33%	57%	10%
2014	207	350	52	34%	57%	9%
2015	251	356	55	38%	54%	8%
2016	227	380	46	35%	58%	7%
TOTALS	928	1500	214	35%	57%	8%

Table 1: Cohort year, number of female minority, male minority and female/male non-minority STEM students

3.3 Data Analysis

Descriptive statistical analysis was used to examine the dataset for female minority, male minority and, female and male non-minority STEM students who met the data analysis criteria described in section 3.1. Descriptive statistics are used to summarize and describe research data in a logical and efficient manner [22]. Google sheets was used to generate the tables and to present the findings.

4.0 Results

The results presented in this section are for female and male minority STEM students (American Indian or Alaskan Native, Asian, Black or African American, Hispanic/Latino, Native Hawaiian or Other Pacific Islander) and female and male non-minority STEM students (white, non-Hispanic). Female and male non-minority data were combined as the female non-minority population was too small to analyze on its own. The data gathered on female and male minority and non-minority STEM students were for first-time freshman, enrolled full time in bachelor STEM degree program for cohort years 2012 through 2016. Graduation and retention data were not available for cohorts after 2016 and therefore the cohort years 2012-2016 were chosen. The graduation and retention data analyzed were from four years after each cohort year. For example, if a student enrolled in 2012, their expected year of graduation would be 2016. This pattern applies to students who enrolled in 2012 through 2016. Also presented in this section is data related to the completion of bachelor STEM degree programs in four years at City Tech, the completion of the bachelor STEM degree program in more than four years at City Tech, and the drop/stop attending rates of minority and non-minority STEM students at City Tech.

4.1 RQ1: Female minority STEM students and male minority STEM *students*

Completion of bachelor STEM degree program in four years

In this section, data related to female minority and male minority STEM students who completed a bachelor STEM degree program in four years was examined and compared.

Four Year Graduation Data for Minority Female and Male STEM Students						
Cohort Year	Female Minority **STEM** Students			**Male** Minority **STEM** Students		
	Cohort Size	**Number**	**Percentage**	**Cohort Size**	**Number**	**Percentage**
2012	95	2	2.1%	156	12	7.7%
2013	148	7	4.7%	258	4	1.6%
2014	207	5	2.4%	350	12	3.4%
2015	251	8	3.2%	356	24	6.7%
2016	227	12	5.3%	380	22	5.8%

Table 2: Female Minority and Male Minority STEM Students who completed the bachelor STEM degree program in four years

Based on the data from five cohort years (2012-2016), male minority students were more likely to complete a bachelor's degree program in STEM within four years than female minority students. However, in 2013, the completion percentage for female minority students was higher (4.7%, n=7) compared to their male counterparts (1.6%, n=4). It is important to note that although male minority STEM students had a completion rate that was higher than that of female minority STEM students, both groups had completion rates that were relatively low (<10%) during this time period.

Completing of bachelor STEM degree program in more than four years

In this section, data related to female minority and male minority STEM students who are still enrolled in a bachelor STEM degree program past the fourth year, was examined and compared.

Graduation Data for Minority Female and Male STEM Students Who Completed the Degree in More than Four Years						
Cohort Year	Female Minority **STEM** Students			**Male** Minority **STEM** Students		
	Cohort Size	**Number**	**Percentage**	**Cohort Size**	**Number**	**Percentage**
2012	95	14	14.7%	156	97	62.2%
2013	148	43	29.0%	258	130	50.4%
2014	207	42	20.0%	350	147	42.0%
2015	251	23	9.2%	356	72	20.2%
2016	227	21	9.3%	380	60	16.0%

Table 3: Female minority and male minority STEM students who completed a bachelor STEM degree program in more than four years

Based on the data collected over the five cohort years (2012-2016), it can be observed that the percentage of male minority STEM students who took more than four years to complete the bachelor's degree program in STEM was significantly higher than that of female minority STEM students.

Drop/stop attending bachelor STEM degree program

In this section, the drop/stop attending data for female minority STEM students and male minority STEM students was examined and compared. The drop/stop attending data examined includes; students who transferred to other non-STEM degree programs within City Tech, students who transferred to other CUNY colleges and students who stopped attending altogether.

Drop/Stop Attending Data for Minority Female and Male STEM Students						
Cohort Year	Female Minority **STEM** Students			Male Minority STEM Students		
	Cohort Size	**Number**	**Percentage**	**Cohort Size**	**Number**	**Percentage**
2012	95	79	83%	156	47	30%
2013	148	98	66%	258	124	48%
2014	207	160	77%	350	191	55%
2015	251	220	88%	356	260	73%
2016	227	194	85%	380	298	78%

Table 4: Female minority and male minority STEM students drop/stop attending data

According to the data collected from the five cohort years (2012-2016), more female minority STEM students dropped out or stopped attending bachelor STEM degree programs than their male minority counterparts.

4.2 RQ2: *Female and male minority STEM students and female and male non-minority STEM students*

Completion of bachelor STEM degree program in four years

In this section, data related to female and male minority STEM students and female and male non-minority STEM students who completed a bachelor STEM degree program in four years was examined and compared.

Four Year Graduation Data for Minority and Non-Minority Female and Male STEM Students						
Cohort Year	Female and Male Minority **STEM** Students			**Female and Male Non-**Minority **STEM** Students		
	Cohort Size	**Number**	**Percentage**	**Cohort Size**	**Number**	**Percentage**
2012	251	14	5.6%	18	2	11.1%
2013	406	11	2.7%	43	6	14.0%
2014	557	17	3.1%	52	4	7.7%
2015	607	32	5.3%	55	5	9.1%
2016	607	34	5.6%	46	2	4.3%

Table 5: Four year graduation data for minority and non-minority female and male STEM students

Based on the data from the five cohort years (2012-2016), it is evident that both female and male non-minority students outperformed their female and male minority counterparts in completing a bachelor's degree program in STEM within four years. However, in 2016, female and male minority students achieved a higher completion rate (5.6%, n=34) compared to their female and male non-minority peers (4.3%, n=2).

Completing of bachelor STEM degree program in more than four years

In this section, data related to female and male minority and female and male non-minority STEM students who are still enrolled in a bachelor STEM degree program (past the fourth year) was examined and compared.

Graduation Data for Minority and Non-Minority Female and Male STEM Students Who Completed the Degree in More Than Four Years						
Cohort Year	Female and Male Minority **STEM** Students			**Female and Male Non-**Minority **STEM** Students		
	Cohort Size	**Number**	**Percentage**	**Cohort Size**	**Number**	**Percentage**
2012	251	111	44.2%	18	14	78%
2013	406	173	42.6%	43	43	100%
2014	557	189	34.0%	52	36	69%
2015	607	95	15.6%	55	19	35%
2016	607	81	13.3%	46	9	20%

Table 6: Graduation data for minority and non-minority female and male STEM students who completed the degree in more than four years

According to the data gathered over the course of the five cohort years (2012-2016), non-minority male and female students had a higher completion rate than their minority counterparts when it came to completing bachelor STEM programs in more than four years.

Drop/stop attending bachelor STEM degree program

In this section, the drop/stop attending data for female and male minority STEM students and female and male non-minority STEM students were examined and compared. The data includes students who transferred to other non-STEM City Tech degree programs, students who transferred to other CUNY colleges and students who stopped attending altogether.

Drop/Stop Attending Data for Minority and Non-Minority Female and Male STEM Students						
Cohort Year	Female and Male Minority **STEM** Students			Female and Male Non-Minority STEM Students		
	Cohort Size	**Number**	**Percentage**	**Cohort Size**	**Number**	**Percentage**
2012	251	126	50%	18	2	11%
2013	406	222	55%	43	0	0%
2014	557	351	63%	52	12	23%
2015	607	480	79%	55	31	56%
2016	607	492	81%	46	35	76%

Table 7: Drop/stop attending data for minority and non-minority female and male STEM students

Based on the data collected from the five cohort years (2012-2016), it is evident that a higher percentage of female and male minority STEM students dropped out or stopped attending bachelor STEM degree programs when compared to their non-minority counterparts. The percentage remained consistently above 50% for female and male minority students throughout the five year period examined.

5.0 Discussion and Future Direction

The findings reveal that female minority STEM students who were first time freshmen and enrolled full time in a bachelor STEM degree programs at City Tech from 2012-2016, had a lower enrollment percentage rate (33-35%) than their male minority counterparts (54-58%) (RQ1). The enrollment percentage rate was even lower for female and male non-minority STEM students (<10%) for this time period (RQ2). It is important to note however, that despite the low enrollment percentage rate for non-minority female and male STEM students, this group had a

higher percentage rate for completing the bachelor STEM program within the four year timeframe than female and male minority students (RQ2). However, the exception was seen in cohort year 2016, where female and male minority STEM students had a higher completion percentage rate (5.6%, n=34) than female and male non-minority STEM students (4.3, n=2). Female minority students had a lower percentage rate for completing the bachelor STEM degree program than male minority counterparts, except for cohort year 2013 where female minority STEM students had a higher completion percentage rate (4.7%, n=7) than their male minority STEM students (1.6%, n=5) (RQ1).

When it comes to completing the bachelor STEM degree program in more than four years, female minority students in the five cohort years (2012-2016) had a lower percentage rate than male minority students (RQ1). Additionally, female and male minority students had a lower percentage rate than female and male non-minority students for completing the bachelor STEM degree program in more than four years (RQ2).

The data indicates that over the five year cohort period (2012-2016), female minority STEM students had a higher drop/stop attending percentage rate compared to male minority STEM students (RQ1). Female and male minority STEM students had a higher drop/stop attending percentage rate compared to their non-minority counterparts (RQ2). Notably, for female and male minority STEM students, the drop/stop attending percentage rate remained consistently above 50%, with the rate for female minority STEM students exceeding 66%.

It is interesting to note that despite having a higher likelihood of completing the bachelor degree program within the four year timeframe and a lower likelihood of taking more than four years to complete the degree, female minority STEM students had the highest percentage of drop or stop attending rates.

These findings offer some initial insight into the challenges faced by female minority students in STEM fields in terms of degree completion and retention. This analysis marks the beginning of a journey to understand their experiences, and plans are in progress for the next phase of this study, which is scheduled for the fall 2023 semester. The next phase will focus on identifying the barriers that these students face and will include activities aimed at improving their confidence, preparedness and sense of belonging.

Section 6.0 presents a proposed plan that consists of two initiatives. The first initiative involves conducting surveys and focus groups to identify the challenges experienced by female minority students in STEM disciplines. The second initiative focuses on promoting exposure to female role models in STEM fields and facilitating peer-led activities to enhance confidence, preparedness, and a sense of belonging. These two initiatives will be implemented concurrently.

6.0 Proposed plan

The study findings underscored the significance of comprehending the challenges faced by female minority STEM students and creating supportive measures to reduce their drop/stop attending rates. The proposed plan consists of two main initiatives aimed at identifying the

challenges faced by female minority STEM students and improving their confidence, preparedness and sense of belonging.

6.1 Initiative One: Survey and Focus groups

To gain a better understanding of the challenges and requirements of female minority STEM students, a survey will be developed in collaboration with the AIRE Office. The survey will be distributed to the target audience through email and the CUNY Navigate System, a communication tool used by students. Once the survey results have been collected and analyzed, a focus group will be conducted to obtain a more comprehensive understanding of the challenges and needs of the target group, and to obtain feedback on potential support and service plans. The findings from both the survey and focus group will inform future initiatives aimed at supporting the academic journeys of female minority STEM students and ensuring their success.

6.2 Initiative Two: Activities

Activity One: Panel Discussion and Q&A

- Description: A panel discussion and Q&A session featuring minority female STEM professionals from various STEM disciplines will be organized. The objective of this panel is to allow these female STEM professionals to share the educational, professional and personal experiences, including the challenges faced and the successes achieved with female minority STEM students.
- Goal: This event will provide female minority students with the opportunity to see themselves represented in the STEM fields and feel a sense of connection with successful minority women in the STEM disciplines [3]. Furthermore, the panel discussion and Q&A session will increase awareness of the various career paths and opportunities available to female minority STEM graduates, which may motivate them to remain in the BTech program and successfully complete the degree within the four year timeframe.

Activity Two: "Sip and Talk" Sessions

Female minority STEM peer leaders will facilitate three "Sip and Talk" sessions during student Club Hours, a designated time for clubs to meet as there are no scheduled classes. The goal of these sessions is to offer a relaxed and informal setting for questions and answers. These "Sip and Talk" sessions are intended to foster a sense of empowerment, representation and belonging among the female minority STEM students who attend[4].

"Sip and Talk" – Job Readiness

- During the " Sip and Talk: Job Readiness" session, a guest speaker from the college's Professional Development Center will be invited to speak on effective resume and cover letter writing, as well as provide tips on successful interview techniques. The guest speaker will also be available to answer questions.
- Goal: The goal of this session is to equip female minority STEM students with the necessary tools to feel confident, comfortable and prepared when applying for STEM

related jobs and internships. This is in line with research that shows that college students are primarily concerned with preparing for future careers [4]. Moreover, being well-prepared can also help alleviate interview anxiety, particularly for minority students [4].

"Sip and Talk" – Internship Process

- The second "Sip and Talk" session will feature the STEM internship coordinators from various STEM departments who will explain the internship processes, share student success stories , and answer student questions.
- Goal: The goal of this session is to empower female minority STEM students with the knowledge and skills needed to navigate the internship process in the STEM disciplines. Lack of information about the available opportunities and the internship process can make the search for internships overwhelming for students. Career counseling and preparation have been shown to be crucial factors in the likelihood of minority students successfully completing their chosen major [23], [24], [25]. Providing students with the necessary information and support will increase their chances of securing an internship in the STEM fields.

"Sip and Talk" – "Ask and Learn – a talk with CST Juniors and Seniors"

- The third "Sip and Talk" session will feature junior and senior female minority STEM students who will share their experiences and perspectives. They will discuss their post-graduation plans and share their internship journey with attendees. The juniors and seniors will be available to answer questions and offer guidance to attendees.
- Goal: The goal of this session is to provide female minority students in the bachelor STEM degree programs with the opportunity to connect with junior and senior female minority students in the same program and gain valuable insights and confidence from their experiences. Peer-led activities have been shown to create a sense of community and increase retention of minority students [18]. Building a supportive network can enhance the academic success of these students.

The findings from these initiatives will be reported at a future ASEE conference.

Work Cited

[1] C. Botella, S. Rueda, E. López-Iñesta, and P. Marzal. "Gender diversity in STEM disciplines: A multiple factor problem." *Entropy,* vol. 21, no. 1, p. 30, 2019.

[2] R. Varma. (2003). "Retention Of Minority Undergraduates In Information Technology" in *Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition, Nashville, Tennessee, June 25, 2003*. pp. 1-10.

[3] D. J. Asai. "Race matters." *Cell,* vol.181, no. 4, pp. 754-757, 2020.

[4] J. Cuseo. *Decided, Undecided and In Transition: Implications for Academic Advisement, Career Counseling, & Student Retention. The First Year of College* ed. Robert Feldman. New York: Psychology Press, 2005.

[5] P. Hall Jr and K. Gosha. "The effects of anxiety and preparation on performance in technical interviews for hbcu computer science majors." In *Proceedings of the 2018 ACM SIGMIS Conference on Computers and People Research, Buffalo-Niagara Falls, New York, June 18-20, 2018,* pp. 64-69.

[6] R. Colwell, A. Bear, and A. Helman, Editors. *Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine: Opening Doors.* Washington, DC: The National Academies Press, 2020.

[7] S. Cheryan, A. Master and A. N. Meltzoff. "Cultural stereotypes as gatekeepers: Increasing girls' interest in computer science and engineering by diversifying stereotypes." *Frontiers in Psychology* p. 49, 2015.

[8] A. Master, S. Cheryan, and A. N. Meltzoff. "Computing whether she belongs: Stereotypes undermine girls' interest and sense of belonging in computer science." *Journal of Educational Psychology,* vol. 108, no. 3, pp. 424–437, 2016.

[9] M. Biggers, T. Yilmaz and M. Sweat. "Using collaborative, modified peer led team learning to improve student success and retention in intro cs." *In Proceedings of the 40th ACM Technical Symposium on Computer Science Education, Chattanooga, TN, March 4-7, 2009,* pp. 9-13.

[10] D. K. Gosser Jr, J. A. Kampmeier and P. Varma-Nelson. "Peer-Led Team Learning: 2008 James Flack Norris Award Address." *Journal of Chemical Education* vol. 87, no. 4, 2010.

[11] S. Horwitz, S. H. Rodger, M. Biggers, D. Binkley, C. Kolin Frantz, D. Gundermann, S. Hambrusch et al. "Using peer-led team learning to increase participation and success of under-represented groups in introductory computer science." *ACM SIGCSE Bulletin,* vol. 41, no. 1, pp. 163-167, 2009.

[12] S. Horwitz and K. Acosta. *Attracting and Retaining Under-represented Groups in Computer Science*. University of Wisconsin-Madison Department of Computer Sciences, 2006.

[13] S. E. Lewis. "Retention and reform: An evaluation of peer-led team learning." *Journal of Chemical Education* vol. 88, no. 6, pp. 703-707, 2011.

[14] T. Newhall, L. Meeden, A. Danner, A. Soni, F. Ruiz and R. Wicentowski. "A support program for introductory CS courses that improves student performance and retains students from underrepresented groups." *In Proceedings of the 45th ACM Technical Symposium on Computer Science Education, Atlanta, Georgia, March 4-8, 1014,* pp. 433-438.

[15] S. Roach and E. Villa. "Enhancing peer led team learning through cooperative learning." *In 2008 Annual Conference & Exposition, Pittsburgh, Pennsylvania, June 22-25, 2008*, pp. 13-549.

[16] C. Stewart-Gardiner. "Using peer led team learning to assist in retention in computer science classes." *Journal of Computing Sciences in Colleges* vol. 25, no. 3, pp. 164-171, 2010.

[17] S.B. Wilson and P. Varma-Nelson. "Small groups, significant impact: A review of peer-led team learning research with implications for STEM education researchers and faculty." *Journal of Chemical Education* vol. 93, no. 10, pp. 1686-1702, 2016.

[18] C. Stewart-Gardiner. "Using peer led team learning to assist in retention in computer science classes." *Journal of Computing Sciences in Colleges*, vol. 25, no. 3, pp. 164-171, 2010.

[19] H. R. Markus and P. Nurius. "Possible selves." *American Psychologist* vol. 41, no. 9, p. 954, 1986.

[20] H. R. Markus and S. Kitayama. "Cultures and selves: A cycle of mutual constitution." *Perspectives on Psychological Science* vol. 5, no. 4, pp. 420-430, 2010.

[21] P. Lockwood and Z. Kunda. "Superstars and me: Predicting the impact of role models on the self." *Journal of Personality and Social Psychology* vol. 73, no.1, p. 91, 1997.

[22] R. W. Cooksey. *Illustrating Statistical Procedures: Finding Meaning in Quantitative Data*. 3rd ed. Singapore: Springer, 2014.

[23] D. S. Osborn, D. K. Howard and S. J. Leierer "The Effect of a Career Development Course on the Dysfunctional Career Thoughts of Racially and Ethnically Diverse College Freshmen." *The Career Development Quarterly*, vol. 55, no. 4, pp. 365-377, 2007.

[24] R. Reardon and E. Fiore. "College career courses and learner outputs and outcomes, 1976-2014 (Technical report No. 55)." *Tallahassee, FL: Center for the Study of Technology in Counseling & Career Development, Florida State University*. 2014.

[25] D. E. Saunders, G. W. Peterson, J. P. Sampson and R. C. Reardon. "Relation of depression and dysfunctional career thinking to career indecision." *Journal of Vocational Behavior*, vol. 56, pp. 288–298, 2000.