Community College Pathways to STEM Education for Women: A Challenge to Gender Stereotypes?

Paper for presentation at the 2013 AERA Annual Conference

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Abstract

Do community college systems of support for STEM (science, technology, engineering, mathematics) education and occupations reproduce or challenge gender stereotypes? Drawing from interviews with administrators, faculty and students as well as a student survey, we examine why so few women enter community college engineering and computer technology programs and what community colleges might do to recruit and support women’s participation in these fields. Key findings show that women are as likely as men to be satisfied with their education and confident they will reach their educational and career goals. Still, pathways into these majors are harder for women to find because college programs are not sensitive to the barriers to STEM that women face.

I. US Community Colleges: Affordable, Accessible, Post Secondary Education For All

Community colleges, perhaps unique to the US higher educational system, offer federal and state subsidized two year post-secondary degrees and vocational certificates to a wide range of students at tuition far below that charged by public or private 4-year or higher post-secondary institutions.\(^1\) Compared with students who attend a 4-year or higher post-secondary institution, students who attend community college are older, poorer, and less academically prepared for post-secondary education. While science, technology, engineering and mathematics (STEM) education in community colleges is typically overlooked as a viable or effective pathway to STEM college degrees and occupations, lessons learned from these institutions bear consideration for improving STEM education. Indeed, the mission of most community colleges

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\(^1\) In 2010, the average annual cost of attending a 2-year public institution was $8,000 to $15,0000 while the cost of attending a 4-year public institution was $13,000 to $22,000. Private 4-year institutions cost as much $32,000 to $40,000 for attendance (Institute for Education Sciences 2012).
is to educate even the most marginal of students through effective outreach, recruitment, and support. Furthermore, community colleges cast a wide net when recruiting students into STEM programs, often without regard to high school mathematics or science coursework, achievement, or even interest in a STEM degree or certificate. By providing developmental coursework to help strengthen foundation for continued work in STEM-related fields and creating outreach activities to teach community members about STEM careers, community colleges function to meet students where they are along the educational spectrum. A potential student’s lack of interest, ability, or knowledge about STEM higher education and careers does not preclude community colleges from seeking them out. Understanding how this is done effectively will enable educators and policy makers to build more effective pathways to STEM higher education and careers, especially for women who tend to lose interest in STEM fields as early as middle school (Hanson, Guilfoy, & Pillai, 2009).

During the past 40 years, community college attendance has risen dramatically with greater proportions of students entering community college directly from high school (Adelman, 2005; Provasnik & Planty, 2008). According to a recent article in the New York Times (Foderaro, 2009), an increase in community college enrollment across the country has led several schools to close admissions early. Between 2000 and 2012, while degrees conferred by public 4-year institutions grew by 41%, degrees conferred by 2-year public institutions grew 80% (Institute for Education Sciences 2012). And in 2008, 35% of all college students attended a community college, and the proportion of women in community colleges was higher than the proportion in four-year degree programs (58% and 51% respectively) (Provasnik & Planty, 2008; Kane & Rouse, 1999).

Researchers attribute the recent rise in community college attendance to several factors, including the 2008 economic recession and the rising cost of four-year degree programs. In 2012, tuition at community college was 36 percent the cost of a public four-year institution and 10 percent the cost of a private four-year institution (College Board 2012). In terms of occupational outcomes, a new report issued by the Georgetown University, Center for Education and the Workforce (2012), 63% of new graduates earning a two year STEM degree earn more than recent 4-year graduates earning a degree in a non-STEM major. STEM jobs, according to the study, are among the nation’s most highly-paid and fastest-growing. In recognition of the importance of community college for workforce development and retraining for the unemployed
and underemployed, President Obama recently committed $12 billion in federal funding to community college education.

A key difference between STEM community college and four-year programs is that students in community college programs can earn vocational as well as academic credentials while study in four-year STEM programs is solely academic (Berkner, Horn & Clune, 2000). The primary goal of STEM vocational programs such as computer systems engineering is to prepare students to enter an occupation after completion of a terminal associate degree or certification. Vocational programs may or may not provide students with the opportunity to earn sufficient academic credit to transfer to a four-year degree program. Students may have the option of following an academic track within the vocational program of study, but it is typically not a necessary component of the vocational certificate. In contrast, the primary focus of STEM community college academic programs is to prepare students to transfer to a four-year degree program. There is no comprehensive research to date that explores gender differences in enrollment in and progress through STEM vocational versus transfer programs. Yet both strands of community college education can lead to well-paying STEM careers (McSwain & Davis, 2007). Therefore, we include both kinds of programs in our analysis of women’s progress through community college STEM programs (referred hereafter as terminal or transfer program) in order to fully analyze STEM community college pathways to higher education degrees and occupations.

Despite the emphasis on vocational education, the majority of community college students aspire to transfer to a four-year degree program of study (Leigh & Gill 2003; Mattis & Sislin, 2005). In addition, 50% of those students who entered community college without plans to transfer to a four-year degree program revised their plans as they progressed towards community college degree completion.

II. STEM Education at US Community Colleges: Where are the Women?

STEM education is significant in community colleges. In 1997, 15.2% of 12th graders who entered a community college wanted to study STEM. In addition, 63.5% of those majoring in a community college STEM program aspired to transfer and 48% of those graduating in STEM did transfer to a four-year STEM program (Adelman, 2005; Chen, 2009). Mattis & Sislin (2005) documented that 40% of science and engineering BA or BS recipients studied at community college at some point during their postsecondary education. In engineering alone, Adelman
(1998) found that 20% of all four-year engineering degrees were earned by students who began their post-secondary education at a community college. Unfortunately, existing research doesn’t allow us to identify the proportion of these students who were women. This lack of knowledge is one example of how little we know about women’s pathways through the community college system, which has prompted this study.

Despite the increased importance of community colleges in preparing individuals for STEM educational and occupational pursuits, little is known about women’s (and men’s) pathways through community college STEM programs. Our limited understanding arises, in part, from a lack of attention given by researchers and policy makers to community colleges as viable and increasingly important platforms to develop and promote STEM education and careers (Bailey, Crosta, & Jenkins, 2007; Calcagno, Crosta, Bailey, & Jenkins, 2007). One exception to this is research conducted by Mattis & Sislin (2005) on *Enhancing Community College Pathways to Engineering*. For this research, an expert panel of STEM educators, administrators, and policy makers, appointed by the National Academy of Engineering and the Board of Higher Education and the Workforce of the National Research Council, selected and analyzed several community college engineering programs that had been particularly successful transferring their students to four-year engineering degree programs. The committee found that strong and ongoing links between two-year and four-year engineering programs was crucial for successful students transfer.

We use the same criterion to select STEM-rich and supported community college programs for our case study research. The committee found these links important for several reasons. First, when administrators and faculty from the linked four-year engineering programs participate in recruiting high school students into the two-year engineering programs, enrollment and transfer efforts were most successful. Second, informal and ongoing relationships between administrators and faculty in the two-year programs with those in the four-year engineering programs allowed for continued improvements to be made in the alignment of curricula, the integration of developmental coursework into the transfer program, and mentoring two-year engineering students (Kincaid et al 2006). Although results were not separated by gender—we do not know if the factors contributing to high transfer rates work as well for women as for men—the committee recognized the potential of community college engineering programs to enhance the gender (and racial) diversity of four-year engineering programs (Ryan et.al 2009; Tsapogas, 2004). Lloyd and
Eckhardt (2010) also explored improving retention in community college STEM programs but not separately by gender. They found that preparing students for advanced coursework, not only in mathematics but in scientific thinking and lab skills, was key for student progress through the two-year STEM curriculum (see also Cohen and Brawer, 1996; Striplin, 1999).

With few exceptions, researchers who have focused on gender difference in progress through community college education have not considered STEM fields. Bryant (2000) demonstrated that, unlike men, women’s persistence in community college was negatively associated with financial constraints, stress, and health problems. Hagedorn, Maxwell, Rodriguez, Hocevar, & Fillpot (2000) found that women were less likely than men to participate in out-of-class activities but more likely to rely on peer groups for academic support.

The Institute for Women’s Policy Research is one exception. In their 2012 report, they find that proportion of women awarded sub-baccalaureate degrees and certificates in STEM disciplines has declined from 33.8 percent in 1997 to 27.5 percent in 2007 (IWPR 2012). Further, data from the National Center for Education Statistics, 2004 Beginning Post-Secondary Surveys showed that only 5% women community college students compared with 15% men began college in STEM. The biggest gender gaps were for Computer Science (8%), Engineering (2%), and Technical Science (4%). There were comparatively few gender difference in biology, math, natural resources, natural science, physical science.

In summary, while prior research has explored the individual and institutional factors that contribute to community college persistence and completion, not as much attention has been given to the STEM fields, specifically how women’s progress through community college STEM programs may be different from men’s. The goal of our research is to fill this knowledge gap by exploring and evaluating the role that community colleges play in developing STEM education and careers for both women and men.

III. Gender and STEM in Post-Secondary Education

While research on gender differences in STEM community college education is lacking, we draw from substantial literature on gender differences in four-year (and higher) educational institutions to inform our models. A considerable body of research has documented women’s under representation in STEM degrees and occupations in four year and higher educational institutions. (Huang, Taddese, & Walters, 2000; Committee on Maximizing the Potential of
Women in Academic Science and Engineering, 2008; Oakes 1990; Valian, 1999; Xie & Shauman, 2003). The research shows that at every stage along the pathway to STEM post-secondary education and careers, women are less likely than men to enter and complete four-year and graduate STEM degrees and, upon graduation, enter a STEM occupation (Joy, 2006; 2003).

Social science theories that explore women’s under representation in STEM fields fall into three broad categories which can be characterized by the emphasis they place on individual versus institutional/social factors in shaping pathways into and through post secondary education and the labor force. Human capital theory which essentializes autonomous individual choice in career pathways locates gender differences in STEM education and occupations primarily with gender differences in ability and preferences (Becker, 1993; Blau, Ferber & Winkler 2009; Goldin, 1990; Ginther, 2006; May 2008). According to this view, students select fields of study based on their interests, goals, or competencies. Human capital theory aligns well with the “leaky pipeline” metaphor, which has been used to illustrate women’s lack of progress in STEM fields (Alper, 1993; Scheibinger, 1999; Sonnert, 1999). The pipeline metaphor conceptualizes a straightforward, rigid and gender neutral pathway through STEM education to STEM occupations where competencies learned along the way prepare students for higher levels of STEM learning. Women are underrepresented in STEM fields because, all along the way, they exit the pipeline at higher rates than men do for motivations having to do with individual preferences or academic abilities. According to human capital theory, the onus for making change is on the individual and not the institution.

Xie and Shauman (2003) expand on human capital theory by incorporating the interrelationships among the domains of education, career, and family in shaping men’s and women’s educational and career outcomes. According to their life course theory, pathways through STEM education and careers are influenced not only by what happens within educational and occupational institutions but also by family relationships across the life course (Maccoby, 1995). According to a life course perspective, the decision to enter a STEM community college program and the ability to complete the program would be inextricably linked with a student’s age, marital and parenting status, and family income. Moreover, because women typically take more responsibility for child care and the household than men, the links between education, career, and the family will be different for men and women (Deutsch F, 1999). Along these lines, X found support from family and community were the most salient and
influential factor that women of color identified as encouraging to their completion of a STEM degree.

While human capital theory also recognizes the role that gender differences in family responsibilities play in STEM education and careers, the emphasis in life course theory is less on individual decision making and more on the social context that makes some opportunities look better than others. For example, whether or not a single mother enters a STEM community college program may have more to do with the availability of affordable child care than the fact that she is a single parent (see also Kellogg). In life course theory, organizational change that recognizes and accommodates the dual work roles of parents would facilitate women’s advancement.

Xie and Shauman (2003), as well as Valian (1999), also recognize the ways in which gender stereotypes or schemas can contribute to gender differences in pathways through STEM education and careers. Gender schema theory locates women’s lack of advancement in STEM with implicit or nonconscious gender hypotheses that overvalue men’s career aspirations and abilities and devalue women’s, especially in reference to male-dominated fields like STEM. In the community college context, gender schema theory would ask researchers to pay attention to the ways in which systems of support (institutions) for STEM education might advantage men’s progress over women’s. For example, men who require developmental math courses may be given more encouragement to enter a STEM program than similarly situated women. Marini & Brinton (1984) has demonstrated that career counseling efforts often reproduce gender segmentation of the labor market by funneling women into typically female jobs like nursing or dental assistant and men into typically male jobs like construction or plumbing. More recently, X found in Denmark(?) that sub-baccalaureate degrees in information technology reproduced rather than challenged gender differences in occupations. Eichner (1994) noted that when a field or occupation is dominated by men, like engineering, bias can creep into job descriptions and educational requirements in such a way as to exclude otherwise-qualified women from entering (see also Bielby, 2000; Fernandez 2003, Reskin & Bielby, 2005). Weinberger (1999, 2001, 2005) showed that women who entered four-year engineering degree programs came from the upper tail of the math-ability distribution while men were drawn from further down in the
distribution, which suggests that women who entered engineering programs exhibited stronger math skills than the men who entered.

Because gatekeepers are often unaware of how gender schemas shape perceptions and actions, gender stereotypes can inadvertently become embedded in organizational structures including policies, programs, and practices. In a community college setting, this can lead to reliance on assessment tests that better predict men’s educational abilities than women’s (Armstrong, 2000) or confusing a lack of aspiration for a STEM education or career for a lack of interest. According to a gender schema perspective, organizational change requires gatekeepers to recognize the ways in which gender stereotypes create different opportunities for men and women in ways that block women’s advancement.

IV. From Pipeline to Pathway

Instead of a pipeline, life course and gender schema theory suggest river metaphor to represent women and men’s pathways into and through STEM education and careers. Rather than an unyielding gender neutral set of pipes to maneuver through, a river is mutable as well as forceful. Consider how a river carves a pathway through the land. The shape of the river depends not only on its own force but by the texture of the soil and rock it moves through. In our model, factors related to human capital theory - individual preferences and abilities that fuel educational and career goals – is represented by the river while gender stereotypes and norms is represented by the surrounding geography which exerts an independent force onto the river’s trajectory, speed, and flow. While the primary focus of human capital theory is on the river in isolation of geography, life course and gender schema theory brings our attention to the complex interplay between water and land. Furthermore, exploration of the interplay between the individual choices and institutional constraints that shape gender differences in STEM allows for the possibility of meaningful organizational change to extend women’s opportunities in STEM.

Park (et al 2011) provides an interesting illustration of how a pathways framework leads to a more nuanced understanding of women’s educational and career choices and potential for organizational change to better support women in STEM. In her study of male and female undergraduates, Park found that women may distance themselves from STEM when the goal to be romantically desirable is activated because pursuing intelligence goals in masculine domains (i.e., STEM) conflicts with pursuing romantic goals associated with traditional romantic scripts.
and gender norms. In an experiment conducted with undergraduates, Badgett and Folbre (1999) found evidence that gender nonconformity in occupational choices reduced women’s attractiveness to men. Viewed through a wider theoretical lens, then, the observation that “women don’t like STEM” is not sufficient explanation for women’s under representation in STEM which from life course and gender schema perspectives is better understood as a social inequity that calls for social and organizational redress.

As we discuss below, by directing our attention to the familial, socio-economic, and institutional contexts within which educational and career decisions are approached and made, a pathways approach, unlike the pipeline approach, offers the potential for a deeper understanding of how organizations reproduce or challenge gender stereotypes and in turn how organizational change can better support women (and men’s) educational aspirations and goals.

Utilizing human capital, life course, and gender schema theoretical frameworks, we focused our research on the following questions:

1. What key policies, practices, and programs support STEM community college education (e.g., student outreach and recruitment, educational and career counseling, interventions for struggling students, and formal and informal mentoring)?
2. How well do these systems of support for STEM community college education meet the needs of female students?
3. How can institutions change in order to better accommodate women’s entrance into and persistence in STEM education and the workforce?

V. Data and Methodology

We applied a mixed methods quantitative/qualitative approach to our analysis of gender in community college STEM programs. Two community colleges with strong programs in Engineering and Computer Systems Engineering Technology (CSET) were chosen for our case study analysis (see description of schools in next section). The Engineering program at these schools prepares students to transfer to a four-year Engineering program while CSET is a two-year terminal degree preparing students for mid-skill level technology occupations like help desk support, network manager, or data-base supervisor.

Qualitative data were collected through interviews with administrators and faculty associated with each of the programs and other college administrators directing student support services in
areas like financial aid assistance, career counseling, and healthcare. We also interviewed students enrolled in Engineering and CSET to gain perspectives on their engagement in and progress through STEM community college education. In the quantitative portion of the research, we gain further information from students perspectives through an online survey of students enrolled in the STEM programs under investigation.

We are currently mid-way through this three year research project. To date, we have conducted informal interviews with the Deans of Engineering and CSET, four faculty in each college, and 32 students in total. We also collected two waves of data through our student survey. During the last year of our research, we will analyze data from the second year of the student survey, complete administrator and faculty interviews, and field and analyze a final wave of the student survey and complete formal interviews with administrators and faculty. Since our research is still in process, results presented here are by definition still preliminary.

**Administrator and Faculty Interview Protocols:** Information gathered from administrators and faculty on systems of support for student engagement included the following kinds of questions: What are the goals of the support systems in place? What are the strengths and weaknesses of the supports as they are currently implemented? What factors should be considered when designing support systems that focus on female students? How might they differ for male students? How are college-wide systems of support for STEM education coordinated? What resources are available (staff, financial, training) to carry out the mission? In what ways are administrators held accountable for student recruitment, retention, and progress through STEM education?

Life course theory directs us to interview financial aid, health, and child care administrators since economic hardships, health concerns, and parenting responsibilities impact STEM students’ ability to reach their educational and occupational goals. We include the following kinds of questions in our interviews with these administrators: What enables STEM students to make progress towards a degree even if they also work full-time? How does the availability of health insurance impact student persistence and completion? In what ways does the college help students access community health services if they are in need? How, if at all, can the college meet student’s child care, transportation, or housing?

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2 We are still in the process of conducting the administrator and faculty interviews so results from this portion of the study are limited and preliminary.
Finally, gender schemas which recognize that women face additional barriers to STEM education and advancement that are often hidden within institutional practices or because of a lack of programs suggest the addition of the of the following kinds of questions to our administrator interview protocols: How has the college established goals for women in STEM recruitment, education, and graduation, and how is progress to these goals evaluated? In what ways are administrators held accountable for assisting women in STEM? How do STEM programs recruit women? What kinds of mentoring are available to women STEM students? How are class schedules arranged to take account of part- or full-time employed students or students with child care responsibilities? In our interviews with faculty, we will also include questions about expectations that faculty address the specific needs of their female students.

Where appropriate, interviews were audiotaped and transcribed. However, in recognition of the oftentimes sensitive nature of the topics under discussion, this may not always be suitable. In these cases, written notes will be taken during and/or after interviews. In our qualitative data analysis, we employ open, and axial and selective coding will enable important and recurring themes to be identified.

**Student Surveys:** To gain student perspectives on their engagement in and progress through STEM community college education, for each year of the three years of the project, we survey students enrolled in the STEM programs under investigation. To recruit students to our student survey, during one week in Spring 2011 and Spring 2012 we made brief presentations to over sixty different Engineering, Physics, Mathematics, Computer Science, and CSET classes – 30 at each school – explaining our research project and interest in learning student perspectives on their educational and career goal, their self-assessment of how well they are able to meet those goals, and their ratings of community college faculty and student services. Students were given a $25 gift certificate to Amazon.com for completing the survey and assured that their responses would remain confidential.

The response rate to our year 1 survey varied by major, school, and gender. For CC1, 65% of the female engineers and 38% of the male engineers completed the survey. For the CSET majors, only 18% of the women completed the survey compared with 34% of the men. At CC2, only 8% of the female engineers (1 out of the 8) responded to our survey compared with 34% of the men. For the CSET majors, all 6 of the female majors responded to our survey.
(100%) compared with 39% of the men. Given the variability in response rates by gender and major, we oversampled women for our student interviews.

To compare and contrast student answers by prior STEM achievement and aspirations, we included human capital variables such as educational and career aspirations, highest math courses completed in high school, and community college developmental coursework. We drew questions from the National Survey of Student Engagement (NSSE) for the student engagement portion of the survey. Students are asked questions regarding their participation in classes, STEM programs outside of class, opportunities to work with peers on projects, faculty mentors, internships, use of the career or transfer services offices, overall quality of the STEM program, and support for educational and occupational goals. We also added to the survey questions that are particularly relevant to community college students, including convenience of transportation to school, availability of child care, and ability to progress through courses even if employed.

Questions drawn from life-course theory were included to capture the intersecting domains of family, work, and school, which all influence student progress. Life-course questions probed the following: whether students have time to participate in STEM activities outside the classroom, whether health issues constrain student participation in classes, and whether child care is affordable and accessible. Since the domain of work and family can be particularly significant to community college students’ ability to advance through their program of study, we made sure to include questions about what factors of support outside of school have been important to their educational progress. In the data analysis phase, we compared gender differences in responses to see if men and women differently assess student systems of support for STEM education and also see how student evaluations of systems of support compare with administrator and faculty assessments. In years 2 and 3 of our project, we also will conduct a brief supplemental survey for students who completed a survey in the previous year. Questions on the supplement probe changes in student self-efficacy, interest in STEM, change in major, if any, and employment related experiences over the prior year.

**Student Interviews:** We recruited students to our interviews at the same time we recruited students to the survey by asking them to put their names and email addresses on a sign-up sheet.

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3 Results from year 2 student survey are forthcoming.
4 In this paper, we present data collected from our year 1 survey. At the time of this writing, we have also completed data collection for the second year of our survey but, at the time of this writing, have only just begun to analyze our data so results are not yet shown. Please contact the author for more information.
if they were interested in participating in a one hour phone or in person interview. In exchange for participating in the interview, we offered students another $25 gift certificate to Amazon.com. Some interviews were audiotaped and for some we took detailed notes depending on the preference of the student being interviewed. To date we have completed a total of 32 interviews, 17 at CC1 and 15 at CC2. We oversampled women in order to gather more information from this under represented group. 33% of the Engineering respondents from CC1 were female while 23% of the Engineering respondents from CC2 were female. For the CSET majors, 64% of the respondents were female at CC1 and 15% of the respondents were female from CC2.\(^5\)

In the protocol for student interviews, we asked students what and who influenced their decision to enter Engineering or CSET as well as what contributed to their decision to attend a CC versus a four year institution. We asked about educational and career goals and what factors were supporting their reaching these goals. We probed into whether or not they felt their college administrators or faculty were aware of challenges students faced, what student services they participated in, and whether or not they helped them make progress towards transfer or graduation. We asked them about their self-efficacy in math and science, ability to reach out to professors, tutoring, and other students for help and support. Similar to the administrator and faculty interviews, while we could not ask directly about gender stereotypes we did ask (both men and women) why in their opinion there were so few women in their major and what, if anything, the college could do to recruit and support women in Engineering or CSET.

VI. **Selection of Case Study Schools**

To choose schools for our case study research, we used the criteria set forth by the National Research Council committee in their selection of model community college engineering programs to investigate (Mattis & Sislin, 2005). The criteria require that the STEM program exhibit strong and established links with area high schools for student recruitment, four-year degree programs for transfer, and professional organizations for career opportunities. For our research purposes, we additionally required the community college to offer both transfer and terminal STEM programs and demonstrate an administrative commitment to building and sustaining STEM education as evidenced by leadership, resources, and special programs to support STEM students.

\(^5\) In the final year of the project, we will interview another 30 students.
Both schools in our case study research meet these requirements. Both of the schools are situated in large urban cities in the same eastern state. Poverty rates in both cities where the schools are located are high; 18% for CC1 and 28% for CC2 compared with a state poverty rate of 11%. Unemployment in the city where CC1 is located is about the same as the statewide average. However, in the city where CC2 is located, the unemployment is about one percentage point higher.

Current enrollment in CC1’s Computer Systems Engineering Technology (CSET) program is 233 students (39 female and 194 male or 17% female). At CC1, program enrollment in CSET has grown dramatically in the past four years, from 77 students in 2007. The percentage of women enrolled in the program has also increased from 12% in 2007 to 17% in 2010. In CC2, there are a total of 101 students enrolled in CSET (6 women and 95 men or 6% women). Between 2002 and 2012, total enrollment in the CSET program grew almost 20% while women’s share of the major fell from 11% to 6%.

At both schools, the CSET program is a terminal degree program that prepares graduates for a broad range of careers in information technology. Graduates are prepared to work in virtually any business or organization that uses computers and computer networks. In CC1, the program curriculum has a well-developed career ladder structure with three certificate programs (Personal Computer Specialist, Network Specialist, Computer Forensics), leading to both industry certifications as well as into one of two degree options. CC1’s CSET program was the first community college program in the country to partner with the EMC Academic Alliance to offer the Storage Technology course. All CSET certificates (in both schools) are (and have been for quite some time) Section 30-approved, which allows unemployed individuals to access extended benefits to complete education and training programs.

Current enrollment in the CC1 Basic Engineering program is 238 students (34 women and 204 men or 14% female). In CC2, the Engineering Transfer program has 101 total students (8 women and 93 men or 8% female). The Engineering program at CC1 grew 15% between 2002 and 2012 while women’s share of the major remained unchanged.6

At CC1, the Basic Engineering (BE) program is unique in several ways that contribute to its appeal as a case study program. Remarkably, there are no requirements to enter the program. While open enrollment is typical for community college, community college STEM programs

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6 At the time of this writing, similar growth numbers from CC1 were not available.
often require students to have met certain math and English competencies before they are allowed into the engineering program. At CC2, for example, students must have successfully completed pre-calculus and Basic English in order to be accepted into the Engineering Transfer program. CC1 opened enrollment to the BE program so that students could become integrated into the program and receive faculty support and counseling from the start of their community college experience.

Prior to this 2006 change in policy, students interested in engineering had to enroll in the general studies program until they had reached a certain proficiency in advanced mathematics and English Language Arts. CC1 found, however, that without support from the BE program, student transfer from general studies to BE was low. After the policy change, while it could take several years for a student to achieve the math and English proficiency to take BE courses, from the time they enter CC1 they are considered engineering students and receive mentoring and support to achieve their goals. Early identification as an engineering student has been crucial in motivating students to stick with the challenging and long-term pre-engineering and engineering course of study.

In both community colleges in our study, students who graduate from the program with a B average or greater are granted automatic entrance as juniors to the highly ranked nearby four-year engineering program. Students often received financial aid to support their education at this private four-year institution. Transfer of the community college BE graduates to the 4-year engineering program is supported by strong ties between the schools’ engineering faculty, department heads, and science deans who have ensured that community college BE coursework is well-aligned with the first two years of engineering coursework at the four year institution. Evaluation and adjustments to the community college BE course of study are made on a regular basis.

In the course of our data collection, we seek to articulate the college-wide and programmatic systems of support for the Engineering and CSET students with a particular focus on their effectiveness for women. While the both programs are STEM rich, women remain underrepresented in these (and most other) community college STEM programs. This suggests that the systems of support in place to support STEM may not be reaching female as well as male students.
In the next section we present key findings from our research to date. By emphasizing both the individual and institutional factors that shape women and men’s involvement and satisfaction with their community college STEM programs, we utilize the pathways metaphor to explore gender differences outcomes. Findings are organized by the key decision points facing students in community college STEM including the decision to enter a community college STEM program, the decision to stay or leave a community college STEM program, and future educational and career plans. At each of these points, students decide whether and how to continue along the STEM pathway depending on the internal and external resources available to support their goals.

VII. Entering a Community College STEM program

STEM Decision Came First:

*Knew back in middle school the option to go to a technical high school. I thought I wanted to be a chef but at open house saw engineer seminars, different trades, found electrical stuff interesting. Went to pre-engineering program in High School.* CC1, Male, Engineer

*In High School there was a technology shop in business communications/technology information. Got experience with software and hardware.* CC1, Female, CSET

With few exceptions, the students we interviewed and surveyed, men and women alike, claimed their decision to study Engineering or CSET preceded their decision to study at a community college. For the Engineering majors, women as well as men chose Engineering because they liked to solve problems, were curious to “know how things work”, and had an affinity towards mathematics. These students wanted to understand the technology and machinery of the world in which they lived in and participate in its development. Interest in Engineering for men and women alike typically appeared at a young age (20 and under with some as young as 10).

Female and male CSET majors also expressed a fascination of technology, working with computers, and solving problems. However, more of the female and male CSET majors, compared to the Engineering majors came to the major at an older age often as a second career and expressed a desire to learn skills that would help them get a secure good paying job.
I was employed in the field and got laid off and I needed to get back in the game. The new requirements all specified associates degree as minimal entry into the positions and preferred BA, so I knew I had to come back to school to be qualified for the same jobs I used to have without any competition. CC2, Female, CSET

Several of these women spoke of how working towards the CSET degree – doing something that took sustained hard work and determination - allowed them to be a role model for their children. In a twist on the usual lifecourse theory of gender differences in careers, being mothers boosted some women’s interest in a STEM field rather than detracting from it.

Next year my son will come to this school. He is an inspiration to me and I am to him. CC1, Female, CSET

I want to show my daughter that she can do anything. CC1, Female, CSET

Some interesting gender differences in selection of these majors also emerged in our data. First, women more so than men chose Engineering for the associate degree, to transfer, job skills, self-improvement, to change jobs, and affordability. Men Engineers slightly more so than women were interested in science.
Several of the CSET women we spoke with had entered the CSET program after losing a job in another field. They expressed a desire to obtain job skills that would provide them a better paying and more secure job than their previous career had offered. In making a career change, women expressed a desire to attain skills that would not only pay well but offer them more opportunities for advancement and respect than their current skills which more often than not were in female clerical or service sector jobs. Several CSET women as well men who had been laid off from other jobs were using their unemployment benefits to retrain in technology. There were also several female and male veterans using veteran’s benefits to train for new jobs in the technology field.

*Knew job in field was growing and had range of wide jobs; hardware, software, programming, etc. and good salary.*

**CC1, Female, CSET**

*I am keeping up my hair dresser license but economy not good for business. I want to go where there is employment. Hard to find a hair dresser job during recession.*  **CC1, Female, CSET**

According to our survey, women who chose the CSET major were more likely than men to want to change jobs while the men were more likely than women to select CSET because of their interest in science.
When asked who was influential in their decision to enter Engineering or CSET, students identified parents, high school teachers, friends and employers. In our interviews with the Engineering majors in particular, we were struck with the number women and men who had other family members who were Engineers. Several of the Engineers we interviewed described how their love of mathematics, building things, and problem solving stemmed from sharing these experienced with a family member.

*I am full of a family of engineers and I fell in love with engineering when I took science and math and physics, problem solving. I just enjoyed everything with engineering.* CC1, Female, Engineer

*My Dad taught me a love for math.* CC1, Female, Engineer

Men, though, were more likely than women to have developed a love of building or technology through playing with toys like Legos and computer games.
Our survey data showed that in addition to a family member, employers, high school teachers, and friends influenced women’s decision to enter engineering. Men, however, were more likely than women to have been influenced by all others except high school counselors and co-workers.

**Recruitment**

Women CSET majors were more likely than their male counterparts to have consulted employers to select major. Men were more likely than women to have consulted parents, friends, other students, and no one.
Decision to enter community college: Affordability, Convenience, and Academic:

Once the decision to study science was made, men and women Engineering and CSET majors chose the community college setting because it was significantly more affordable than a 4-year program and was conveniently located to where they lived and worked. Several of the women and men Engineering and CSET majors also chose the community college because they needed to build their academic skills or had learning disabilities that they felt were better supported at the community college. One male student that caught our attention had very strong math skills but felt he lacked the English language skills to be successful at a competitive 4-year Engineering program. He chose the community college to build his English language reading and writing skills while also pursuing the first two years of an Engineering degree and planned to transfer to a highly ranked 4-year program at the completion of his community college studies.

Vicinity and my mom came here.  CC1, Male, CSET

Brother came here. A lot of Ghanaians here from church. Took classes here while I was only a junior in HS.  CC1, Female, Engineer

Interested in CSET program knew of this community college, thought classes smaller, more one on one, if I had
questions, I’d be able to ask them and get a good answer rather than large lecture.  

CC2, Male, CSET

Moved here after military training and needed a quick calculus class. This was convenient.  

CC1, Female, CSET

A few of our the men and women engineering students we interviewed, in addition, had begun their engineering studies at a four-year college but had transferred to the community college because they had done poorly at the 4-year college. They sought the community college as a place to get more focused help and academic attention, slower paced and smaller classes, and an institution that would be less risky financially should they need to leave for academic or other reasons. For the CSET majors, the community college was the only institution to provide the one or two year certificates to prepare them for immediate IT work. Even so, many of the CSET students aspired to eventually completing a 4-year degree if not directly after graduating from the community college then after a few years in the labor force.

My math skills not good; didn’t want to waste money at 4-year. I needed a lot of math that went back to algebra. To pay this at 4-year made no sense. Also, wanted to test interest in engineering at CC.  

CC1, Male, Engineer

Not doing so well in mechanical engineering at 4-year school in Florida so came to CC as transfer.  

CC1, Female, Engineer

Recruitment of Women: Given the low numbers of women entering Engineering (14% of the major at CC1 and 6% at CC2) and CSET (18% of major at CC1 and 8% at CC2), we wanted to explore what the community colleges did to recruit women into these programs. What our interviews with administrators and faculty revealed, however, was that gender had not been a consideration in the recruitment, support, or engagement of women in either the Engineering or CSET program. For example, a high level administrator at one of the schools responsible for STEM education was surprised to learn how few women were enrolled in the school’s Engineering program. They were not aware of the data. When we the information was made available to the administrator, the administrator was dismayed at the lack of time and resources
available at the college to recruit more women into the program. We were told that, “Just keeping up with the educational goals for the students already in the program was difficult and recent budget cuts exacerbated their recruitment and retention efforts for all students not just women.”

Neither of the Engineering or CSET programs at either school had set department goals for increasing women’s participation. A typical response from administrators and faculty to the question, “Why are there so few women in Engineering and CSET was, “I am not sure. Women just don’t seem interested.”

Our research showed that the community colleges lacked programs to recruit and mentor more women in STEM fields. Yet, the suggests that there exists an untapped pool of women, potentially interested in and educationally prepared in science who might consider the Engineering and CSET programs if they were provided with information about educational and career opportunities in these areas and if institutional bridges between health, business, and general studies curriculums were better articulated. For example, in one community college, most of the women taking an introductory physics class did so in order to apply to the sonography (ultrasound) technician program. Because over 200 (mostly) women applied to the program annually but only 10 were accepted, achieving an A in physics had become a defacto requirement for just applying to the sonography program. Due to the low acceptance rate into sonography, though, very few women gained entrance. Educational guidance was not available to counsel these women on alternative science programs and careers that they would be qualified for given their achieving a high grade in Introductory Physics. Similarly the nursing and other medical programs at both community colleges continue to be oversubscribed with many more applicants than not gaining admittance. Programs in place to educate women on alternative career paths in STEM - along with clearly articulated pathways from a health or general studies program of study to Engineering or CSET - has the potential to boost female enrollments in community college STEM.

VIII. Satisfaction, Self-Efficacy, and Retention in Community College STEM

7 This lack of interest in recruiting more women into STEM community college programs appears to be more widespread than just our case study schools. At a recent presentation of research at the national community college association, out of about 100 panels, only two were focused on women, in general, and one on women in STEM.
Satisfaction and Self-Efficacy: Once they entered the community college CSET or Engineering program, the women in our sample expressed strong satisfaction with their studies and high levels of self-efficacy. Despite being in the minority to the point of often being the only “token” women in the class - the women in our samples were as likely as men to feel confident in their abilities to complete their educational goals, find support to help them reach their goals, and confidence in their mathematical skills. Women were as likely as men to feel confident that they would be successful in the STEM careers they were training in; the one exception to this was that women were more likely than men to think that women’s lack of representation in STEM occupations would make a STEM career more challenging for women.

*With me computers, I just get it.*  **CC1, Female, CSET**

*No, challenge that I can’t overcome and more women should join engineering too. Women don’t like math and science and I have a passion for it and I want to influence more women to join.*  **CC2, Female, Engineer**

*I want to get the AA (2-year degree) and then BA (4-year degree) and then keep studying. Never want to leave too much time without learning new things.*  **CC1, Female, CSET**
It is very important to me to finish Educ. I am confident I will find a job in my field. Confident I can reach my educ goals Can find help that I need

Confidence in Educational Goals (n=131), Source: CCSTEM Student Survey 2011

- It is very important to me to finish Educ.
- I am confident I will find a job in my field.
- Confident I can reach my educ goals
- Can find help that I need

Engineers Female
Engineers Male
Institutional Systems of Support

When it comes to school systems of support for students, to a surprising degree, neither women or men Engineering and CSET students used the services provided at their community college including the library, Health Services, Registrar, Career Services, Financial Aid, Academic Advising, Tutoring, Disability Services, Counseling, and Child Care. Of those services that students did frequent including the financial aid office, academic and career advising, and tutoring, students gave mixed reviews of their helpfulness depending on the school under consideration. Students at CC1, for example, found the math and physics tutoring services extremely helpful in preparing them for exams and to complete coursework. At CC1, the tutors were often alumni of the Engineering program so very familiar with both coursework and professor’s teaching style and requirements. Several students (female and male alike) attributed their ability to “get through the math or Engineering classes” to their tutors. Students at CC2 found tutors to be less helpful mainly because there were no tutors for the advanced mathematics or physics classes.

Confidence in Educational Goals (n=115),
Source: CCSTEM Student Survey 2011

- It is very important to me to finish Educ.
- I am confident I will find a job in my field.
- Confident I can reach my educ goals
- Can find help that I need

CSET Female  CSET Male

- Confidence in Educational Goals (n=115),
- Source: CCSTEM Student Survey 2011

- It is very important to me to finish Educ.
- I am confident I will find a job in my field.
- Confident I can reach my educ goals
- Can find help that I need

CSET Female  CSET Male
Students from both schools found academic advising to be best when it came from a faculty member in their major rather than the community college academic advising center. Faculty Engineering or CSET, according to students, were in the best position to guide students through their courses of study, to help insure they would meet requirements to complete the major in a timely fashion, to transfer to a 4-year program or enter an occupation after graduating. Students who had relied on the community college advisers spoke of being led “off track” by their advisers and “wasting time and money” in courses that in the end did not help them complete their major requirements.

Overall, the most important point of contact students had in their community college was the faculty in their program of study. Faculty were for the most part rated very highly by students for providing good support with classwork, helpful and timely feedback, and clear expectations. Although it is important to note that there was some dissatisfaction with particular faculty as well that came from both the male and female students evenly and which may depend on how well student is doing in the program. On the whole, though, women and men students alike felt their faculty consistently went out of their way to be available to students outside of class and via email, were understanding and flexible when a student’s job or family responsibilities made attending classes or turning in homework challenging, and providing mentoring about future educational and career opportunities.

*Instances where information too generalized. Like drinking from a fire house; get what you can get and miss the next. We skim over a lot. Being prepared for everything in four chapters too much. Need more specific targeted help. In order to transfer, nothing less than B-. Other profs, will help you focus on what is tested; study what is important rather than everything which makes it more manageable.*

**CC1, Male, Engineer**

*Good support, nothing bad has happened. Adviser will support you if you are doing well. Great support from students and teachers if you do well. **CC1, Female, Engineer**

*Yes, a lot of helpful feedback, if you shoot them an email, they respond in an hour, at any time. And they give a detailed account. **CC2, Male, Engineer***
Retention: When it comes to the intention to complete a course of study in Engineering or CEST, our research did uncover some significant differences by gender. First, women were more likely than men to have taken a leave of absence from school.

Since a leave of absences makes graduating less likely, women’s higher leave taking put them at a greater risk for not finishing their degrees. Women were also more likely than men to acknowledge that entering a male-dominated field would be a challenge for women. As we discuss further below, this perception may have emerged from some of the challenges that women experienced as a result of being in a heavily male-dominated educational environment. Finally, for both the Engineering and CSET majors, women were more likely than men to consider changing majors to health, general studies, or business which suggests an underlying dissatisfaction with the Engineering and CSET programs. Since the Engineering women were more likely than their male counterparts to be considering an alternative program of study in another science field, a lack of interest in science does not appear to be the motivating factor underlying women’s desire to switch. Rather, the dissatisfaction may have more to do with displeasure with Engineering as a field of study or career or, more narrowly, women’s particular experiences as “tokens” in their current programs of study.


Negotiating Gender: Through the course of our recruiting and interviewing students, it became apparent that a key factor in women’s decision to enter and succeed in their community college Engineering or CSET program was how well they negotiated the contradictory roles of
being female and being geek. Both the men and the women we interviewed described themselves as being “geek like” when it came to their Engineering or CSET studies and interests. Terms to describe “geek” included the following: an obsession or love for technology, building things, and computer games, enthusiasm for science fiction, longing to know how things work, high interest in mathematical and scientific thinking, not as interested in socializing as their non-STEM friends were.

When asked, “what was the most surprising thing they had learned since starting their program of study?” the most common answer given was that it was “hard work”. Many of our respondents were not prepared for college level coursework when they began college; one of the main reasons why they chose study at a community college rather than a 4-year institution were smaller classes, slower paced curriculum, tutoring, and support for learning disabilities. Stick-do-edness, determination, and self-motivation were qualities students deemed crucial to successfully completing their programs of study. Indeed, we found the determination that some students startlingly. One man was in his sixth year of what is purportedly a two year course of study in Engineering. Because he had failed courses that required retaking and was only able to attend school part time (because he also worked part-time) it was taking him much longer than most others students to finish. Still, he was determined to finish with a high enough GPS to transfer to a 4-year Engineering program. A woman Engineering major at the same school had to retake Calculus II three times before she passed. She had done so well when she finally passed, that she was currently working as a part-time tutor for the class while she finished her degree. She transferred to CC1 after failing out of a 4-year Engineering program.

What is relevant here in terms of gender, is how the women, but not men, described being “geek” – devoted to their STEM education – contradicted their being “typically female”. It was as if being traditionally female had to be suppressed or overcome or (re)engineered in order to be a successful Engineering or CSET major. Women had to work extra hard to “fit into” the male-dominated culture they confronted in their classes which included “boy talk” which some women and men found offensive to women, strong mathematical ability, determination to succeed, and a love of technology. For their part, the men in our samples felt that the women did a good job “fitting in” to the male-dominated culture often describing them as “not like other women” or “just one of the guys.” Both male and female Engineering and CSET majors described peer
study and work groups as the most important source they received in their programs. From this perspective, “fitting in” was more about being liked but a key strategy of success.

*I’ve always been an against the grain kind of person. I think it’s fantastic, it’s male dominated, you can see it in the classes, and it’s funny when you’re one or two women. We just want to show what we can do. We are powerful strong women working together to do this.*  CC1, Female, Engineer

Women less secure about their abilities because engineering more challenging. Stereotypes of nerd types but I like this. Girls not as interested in video games or robotics compared to guys.  CC2, Female, Engineer

*Lack of girls in Computer Science due to stereotypes. A lot of guys in CSET into video games and girls are not. And games lead to interest in technology. Games are nerd/geek thing. Girls are into what they want to wear. I don’t fit into either of these stereotypes.*  CC1, Female, CSET

*There are so few women in Engineering maybe because engineering is a lot of knowledge. For women, Engineering is too theoretical, too hard.*  CC1, Male, Engineer

*We are all geeks. This is the only place where I see everyone as just somebody. Not male or female, pretty or not, just an engineer. I see I can teach you and you can teach me. All equals. Age not an issue.*  CC1, Male Engineer

*If I were a woman, I would be intimidated. The women in Engineering say I want to be an engineer. But if not interested will choose nursing. Women are hardcore wanting engineering.*  CC1, Male, Engineering

*Not a problem here but out in the world women engineers not seen as feminine. Men are intimidated by smart women. But we accept the girls here in this program.*  CC1, Male, Engineering

Many of the women in our samples had prior educational or work experiences in highly male-dominated environments. These experiences may have given them the opportunity to (re)negotiate for themselves and others what it meant to be female and geek before starting in
community college STEM. For the Engineering women, these experiences included joining an all male-robotics team in high school or growing up in a family with male engineers. In the CSET major in particular several of the women had been in the military or had work experience in heavily male-dominated environments. One woman, for example, had retired from the Navy after having served as one of the first groups of women to serve on an air craft carrier. Another had served in Iraq as the only female meteorologist.

Women can get overwhelmed with men taking over leadership; Type B personality won’t be as involved as possible. Type A, dominant back towards men will excel more, stand up to men who outnumber them. CC1, Female, CSET with prior military experience.

Even though women felt different from other women in their identity and capacity for work in advanced mathematics, physics, engineering and computer science – and men felt that women in their programs were highly capable and like “one of the guys” - women, unlike men, felt they still had to prove their academic strengths and capacity for long focused work to be fully accepted by the men they studied with. In addition to doing academic and gender work, then, women had to work to be seen as competent.

Women also had to have “thick skin” when it came to the “boy talk” that occurred in labs and work groups that made the atmosphere feel, at time, hostile or offensive to women. One example we noticed to illustrate this was in a CSET lab where the only woman in the class sat next to a male student who had a pornographic image on his computer’s screen saver - which was facing away from the professor towards the back of the room.

Had a bad experience last year. Taking computer apart and volt testing, I made a mistake. Other men in class made fun of me because I had made a mistake. Other male students said I would drop out. I did speak to professor about this who wanted to address class but I was embarrassed to have whole class addressed. CC1, Female, CSET

Definitely we have to assert things like boundaries… I’m sensitive to those things, but I can’t go around fighting battles every day because it will take away my focus. I’m here to learn. If I’m combative, I can’t join study groups. There’s no tutor to help. I need to pay attention in class and work with the people in the room. It’s not pleasant
sometimes, but you have to deal with it. There are other
women in my classes, they get up and walk out of room and
they miss stuff and they’re angry and bitter. It can get to
you, but you have to find a way to make it work. It’s pretty
much the same in the workplace too, it depends on
workplace. CC2, Female, CSET

IX. Breaking Gender Stereotypes Through Organizational Change

In answer to our original questions, our research suggests that community college efforts
to support women and men already in Engineering and CSET majors is gender neutral in that
policies and programs to support STEM education are applied the same to both women and
men. For the most part, these programs, policies, and practices which include strong ties
between Engineering and CSET faculty and students, clearly articulated transfer agreements
between 2 and 4-year engineering programs, flexible and manageable financial aid
assistance, and tutoring were rated the same by the men and women in our samples. As a
result of this support, and student’s individual drive, women as well as men at both
community colleges had high levels of satisfaction, connection to faculty, confidence in their
scientific and mathematical thinking, and self-efficacy in reaching their educational and
career goals.

However, in addition to the academic work needed to be successful, women but not men
also had to work to overcome contradictions between being female and being geek. This
work involved redefining for themselves and others what it meant to be female – often
setting themselves apart from the typical stereotypes associated with femaleness, proving
their academic determination and capability, and fitting into peer groups as “one of the
guys.” This work involved making the men around them feel comfortable being around them
to the point where their femaleness was not longer apparent.

Perhaps it is a result of the extra work afforded women in Engineering and CSET that so
few women enter these majors. The bar to enter these majors – even at the community
college level where the mission is to educate all students – is set very high for women. These
hurdles women face entering and succeeding in community college STEM programs do not
have to do with having well enough mathematical or scientific reasoning skills. On the
contrary, community colleges offered both women and men opportunities to build their math
skills up from a remedial level in order to enter the Engineering or CSET program. For
women, barriers to entry and completion had more to do with negotiating their femaleness while also attempting to fit into the male-dominated cultures which imbued relationships, support, and learning. While the women we surveyed and interviewed had made this leap, it is unlikely that more women will enter these programs without recognition by community colleges of how contradictions between gender and geek stereotypes close off educational opportunities for women in their institutions.

From our data, we learned that most of the women and men who entered Engineering and CSET decided on these areas of study prior to entering the community college. The community colleges had no policies, programs, or practices in place to help direct other potential students into Engineering and CSET; students who had never previously considered these fields because they lack information about educational and occupational career paths in these fields and perhaps because they did not see themselves as able to “fit in” with the geek stereotypes and male-dominated culture. Importantly, this gender neutral lack of career and educational counseling services inevitably impacts women more so than men. Because of gender stereotypes and socialization men naturally come across more opportunities than women to explore Engineering and computer experiences - through play, engagement with family members, school, extra-curricular activities, and summer programs. Pathways for women into Engineering and CSET are harder to find since this entails breaking with the dominant gender paradigm. Complacent with the notion that, “Women are just not interested in studying Engineering or CSET,” the community colleges fail to recognize the large untapped pool of science focused women who may with some guidance be eager to find a pathway into these male-dominated fields of study.

More than gender sensitive guidance counseling, however, is needed for change. Our research suggests that the women who enter Engineering and CSET already passed a very high bar in terms of their interest, commitment, and determination to graduate in a highly male-dominated area of study. Their high levels of self-efficacy, we conjecture, come not from the programs themselves - which do not pay attention to gender in terms of recruitment, curriculum, mentoring, or career guidance - but from factors outside the institution. If these colleges want to serve as agents of change and successfully recruit more women into Engineering and CSET, they very well may have to address the fact that “Women are not
interested in these subjects,” by considering how the programs themselves – and pathways into them - could be altered and made more relevant for women

The Institute for Women in Trades and Technology offers some clues as to what community colleges can do to attract and retain more women in STEM fields. They include:

- Using customized outreach and recruitment materials that show women in STEM and non-traditional Technology fields, attract and inspire women and dispel misconceptions.

- Acknowledge and identify the specific cultural and environmental barriers that women face in STEM and address them in career and academic counseling, tutoring, and in classes.

- Institutional structures that build relationships among students and between students and faculty, and faculty and administrators to help combat stereotypes and misconceptions, and provide students with support, guidance, and motivation.

- Relationships among students, and between students and faculty, and faculty and administrators help combat stereotypes and misconceptions, provide students with support, guidance, and motivation.

- Using data to help identify what the problem is and after program implementation knowing if the intervention was effective.

In addition, our research suggests that institutions take a zero tolerance stand against sexually harassing or offensive behavior by with clearly implemented accountability systems and trainings for administrators, faculty, and students.

X. References


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