Breaking Barriers: Attracting Female Students to Construction Engineering and Management Undergraduate Programs

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Abstract

The construction industry is widely recognized as a male-dominated environment, which has presented challenges in attracting qualified female employees. The considerably low female student enrollments in construction engineering and management (CEM) undergraduate degree programs have continued to draw attention from academia. This study focuses on a cohort of female students in a CEM program at a regional university in the Northeast. It examines the students' CEM degree choice decision, their learning experience, and the strategies for attracting more female students to CEM programs. This study identifies the factors that influence female students' choices in pursuing CEM degrees and suggests strategies to encourage and attract more women to study and work in the industry. The results of the study highlight that personal interest in construction and career opportunities are the most significant factors influencing female students' decisions to major in CEM. Furthermore, the majority of students reported positive learning experiences during their studies. The findings inform recommendations for CEM program recruitment efforts. The recommendations include collaborating with a Professional Women in Construction chapter to provide prospective students with increased opportunities for engagement within the construction industry. Additionally, enhancing advertising efforts through social media platforms and the internet, featuring female guest speakers, and providing high school students and counselors with up-to-date information on CEM programs are strategically significant actions to address the gender imbalance in the field.

Introduction

The construction industry is widely recognized as a male-dominated environment,[2] posing significant challenges in attracting and retaining qualified female employees. This gender disparity is particularly evident in the considerably low enrollment of female students in construction engineering and management (CEM) undergraduate degree programs,[13] a trend that has drawn increasing attention from academia. Despite ongoing efforts to promote gender diversity and inclusion, the underrepresentation of women in CEM programs persists, highlighting the necessity for targeted interventions to rectify this imbalance.[6]

As the industry experiences rapid global expansion, there is a heightened demand for skilled professionals in construction management and related fields.[3] The urgency to replenish and expand the construction workforce is underscored by these projections, emphasizing the critical need for CEM programs to produce a sufficient number of qualified graduates to meet the escalating demand.

In today's landscape, there is a growing emphasis on diversity and inclusion, recognizing women as valuable contributors to the construction industry. However, despite this recognition, there remains a significant under-recruitment of female students in CEM programs, with male students continuing to dominate enrollments. While previous research has explored strategies to attract

and retain female students in construction education, there remains a substantial gap in understanding the specific challenges faced by female students in CEM programs. Addressing this gender gap in CEM program enrollment is crucial for fostering a more inclusive and equitable environment within the construction industry.

This study centers on a cohort of female students enrolled in a CEM program at a regional university in the Northeast. The study aims to explore various facets of their educational journey, including their decision-making process in selecting a CEM degree, their learning experiences within the program, and the strategies employed to attract more female students to CEM programs. By examining the factors that influence female students' choices in pursuing CEM degrees and proposing strategies to encourage and attract more women to the industry, this study seeks to contribute valuable insights to the ongoing discourse on gender diversity in construction education.

Literature Review

The underrepresentation of female students in CEM programs has persisted as a long-standing issue within the field.[13] Despite ongoing efforts to promote gender diversity and inclusion, the enrollment of female students in these disciplines continues to lag behind that of their male counterparts. This literature review aims to explore the various factors surrounding female students' enrollment in construction and engineering education, encompassing societal perceptions, institutional barriers, and strategies for fostering greater gender diversity.

Previous research efforts highlight the multifaceted factors influencing the underrepresentation of female students in construction fields. Societal perceptions, stereotypes about gender roles, institutional barriers within educational settings, the lack of female role models, cultural environments, labor market opportunities, and individual motivations all significantly contribute to shaping the observed gender disparities in CEM education and occupations.[10,12]

One primary factor influencing female students' enrollment in CEM education is societal perceptions and stereotypes regarding gender roles. From a young age, children are often socialized into traditional gender roles, with boys encouraged to pursue STEM fields while girls are directed towards more "feminine" subjects.[1] This societal bias can manifest in educational settings, where girls may feel discouraged from pursuing careers in construction and engineering due to perceived gender norms and stereotypes.

Moreover, the lack of female role models and representation in construction fields can impact female students' enrollment decisions. Exposure to female role models in the fields has been shown to positively influence girls' interest and confidence in pursuing construction and engineering careers.[11] However, the underrepresentation of women in construction professions means that female students may have limited exposure to such role models, contributing to feelings of isolation and disengagement.

Institutional barriers, including biased evaluations, limited resources, and a lack of mentorship opportunities, also create a hostile academic environment for female students and further

exacerbate feelings of isolation.[4] Research has demonstrated that women face various forms of gender bias and discrimination in construction fields, which can deter them from pursuing careers in construction and engineering.[5] Addressing these barriers and promoting inclusivity are essential for fostering greater gender diversity and ensuring equal opportunities in CEM education and occupations.

Cultural environments and labor market opportunities also influence gender gaps in expectations and career choices, with certain construction and engineering fields characterized by masculine cultures that may signal lower belonging for women.[1] Additionally, individual motivations and values, such as intrinsic values and social utility values, influence young people's decisions to pursue CEM degrees and careers.[11]

Despite the challenges, various strategies can be implemented by educational institutions and stakeholders to promote greater gender diversity in the fields. These strategies include:

- Outreach and Engagement Programs: Educational institutions can develop outreach and engagement programs aimed at encouraging girls to pursue careers in construction and engineering.[8] These programs may include hands-on workshops, mentorship opportunities, and exposure to female role models in the field.
- Addressing Implicit Bias: Training programs can be implemented to address implicit bias and promote gender-inclusive practices among faculty, staff, and students.[7] This initiative can help create a more welcoming and supportive environment for female students in construction and engineering programs.
- Creating Supportive Networks: Establishing supportive networks and communities for female students in construction and engineering programs can provide a sense of belonging and support.[9] This can be achieved through student organizations, networking events, and peer mentoring programs.

Through the literature review conducted in this study, it is evident that addressing gender disparities in construction education and occupations requires a comprehensive approach that addresses societal perceptions, institutional barriers, lack of representation, cultural environments, labor market opportunities, and individual motivations. By comprehensively addressing these multifaceted factors, CEM programs can strive towards creating more inclusive and equitable pathways for female students in the fields. Furthermore, they should identify methods to combat implicit bias, establish support networks, and promote greater exposure to female role models in the field. Through the implementation of these strategies, educational institutions can progress towards fostering more inclusive and diverse learning environments in construction and engineering education. Figure 1 summarizes barrier surrounding female student’s enrollment in CEM education.

Methodology

This study centers on a group of female students currently enrolled in a CEM program at a regional university in the Northeastern United States. It seeks to investigate the experiences, motivations, and challenges encountered by these students as they pursue degrees in CEM.

Additionally, the study aims to explore strategies for enhancing the recruitment and retention of female students within the author's university program.

Figure 1. Barrier Surrounding Female Student's Enrollment in CEM Education

To achieve the study's objectives, small focus group interviews were conducted. Participants from sophomore to senior levels were selected and divided into small groups to facilitate in-depth discussions. Each group consisted of three participants to ensure active engagement and meaningful interaction. For this study, a semi-structured interview protocol was developed to guide the discussions, incorporating open-ended questions to explore participants' experiences, motivations, and challenges in pursuing a degree in CEM. The interviews took place in a comfortable and private setting to encourage open and honest communication, and field notes were taken to capture contextual information. At the end of focus group interviews, a follow-up questionnaire was distributed to quantitatively measure the gender disparities surrounding female student's enrollment in the author's university program.

Data Analysis and Results

To assess the extent of issue on female student's enrollment, the study analyzed the annual number of female graduates in comparison to male graduates over the past decade. Figure 2 illustrates the comparative analysis.

This study aims to explore the experiences and perspectives of female students enrolled in a CEM program, focusing on the factors influencing their decision to pursue CEM degrees and

their experiences within the program. Small focus group interviews were conducted with six currently enrolled female students, comprising two sophomores, two juniors, and two seniors. The purpose of these interviews was to gather insight into their motivations, challenges, and decision-making processes regarding their degrees in CEM.

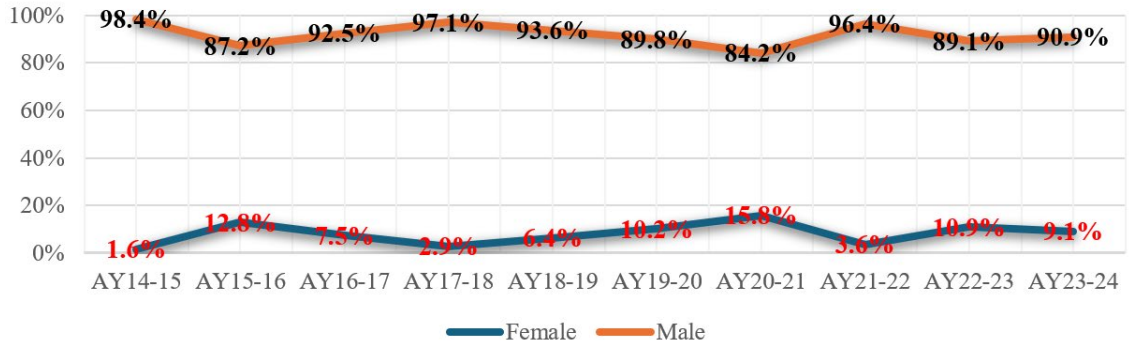

Figure 2. Female vs. Male Graduates Over Time

During the interviews, participants were queried about several key aspects, and their responses are summarized below:

1. **Influences on Decision to Pursue CEM**
   - One group was inspired to pursue a degree in CEM after exposure to the field through a trade school program in high school and influence from the HGTV show "Fixer Upper." Despite initially considering a direct entry into the construction field, they were encouraged by their shop teacher to explore construction management, recognizing the potential career opportunities it offered. This decision was made during their junior year of high school.
   - The other group's interest in CEM stemmed from their upbringing, particularly influenced by their father's or aunt's occupation as a carpenter, plumber, and contractor. They were initially undecided between pursuing majors in architecture or engineering until their father or aunt suggested CEM due to its diverse career paths, both on-site and in the office. They ultimately chose CEM as their major during their senior year of high school.

2. **Perceptions of Gender Diversity**
   - One set of participants reported a positive experience, asserting that despite occasionally being the sole female student in certain classes, they encountered no differential treatment from male peers or professors.
   - Conversely, another group highlighted the low gender diversity within the program. Several respondents noted being among very few female students, sometimes even the only female in their classes. Although the presence of some female teachers served as role models, the overall lack of female representation indicated a significant gender disparity within the program.

3. **Perceptions of Gender Representation in the Construction Industry**

- One group highlighted a positive trend of increasing female presence and acceptance in the construction industry. They cited personal experiences at Manafort Brothers and Whiting-Turner, where they felt respected and accepted by male colleagues. While acknowledging they cannot speak for all women in the industry, they indicated not facing discrimination based on gender.
- Conversely, the other group emphasized the lack of female representation in the construction industry. They recounted instances of being the only woman on jobsites and expressed concerns about not receiving respect from male counterparts, which they feared could impede their career progression, particularly in roles like superintendent.

4. **Awareness of Diversity Initiatives in the Industry**
    - The first group emphasized the importance of raising awareness about careers in construction field, especially among females. They noted that these career paths are not as widely known as architecture or engineering careers and suggested that making information about the industry more accessible could encourage more women to pursue careers in construction.
    - The second group highlighted the impact of attending a "Women in the Trades" conference during high school. They shared how successful women in the construction industry shared their experiences and inspired attendees to pursue careers in construction. Additionally, they mentioned attending other events aimed at educating high school girls about the benefits of working in trades, which further motivated them to pursue degrees in construction.

5. **Recommendations for Encouraging Female Enrollment in CEM**
    - One group emphasized the importance of promoting various career paths within the CEM degree to encourage female enrollment. They suggested highlighting successful women in the industry to inspire young girls and emphasized the need for a curriculum that focuses on universal standards rather than gender-specific modifications.
    - The other group proposed having more successful women in the industry speak at open houses and events to demonstrate the possibilities for female students. They also advocated for promoting the versatility of the CEM degree and organizing events specifically aimed at promoting gender diversity in non-traditional majors for women, featuring advice from women in various trades.

Following the completion of the focus group interviews, each participant was asked to complete a follow-up questionnaire aimed at quantitatively assessing perceptions regarding gender disparities in female student enrollment within the author's university program. Perceptions were assessed using a response scale ranging from 0 (no concerns) to 4 (significantly important) across various gender disparities. As shown in Figure 3, 'lack of representation' emerged as the primary concern, followed by individual motivations. In the context of increasing focus on diversity and inclusion, 'societal perceptions and stereotypes' and 'cultural environments' were rated slightly below neutral. Participants indicated that 'institutional barriers' were of minimal concern. Given the current demand for replenishing and expanding the construction workforce, 'labor market opportunities' were not viewed as a concern.

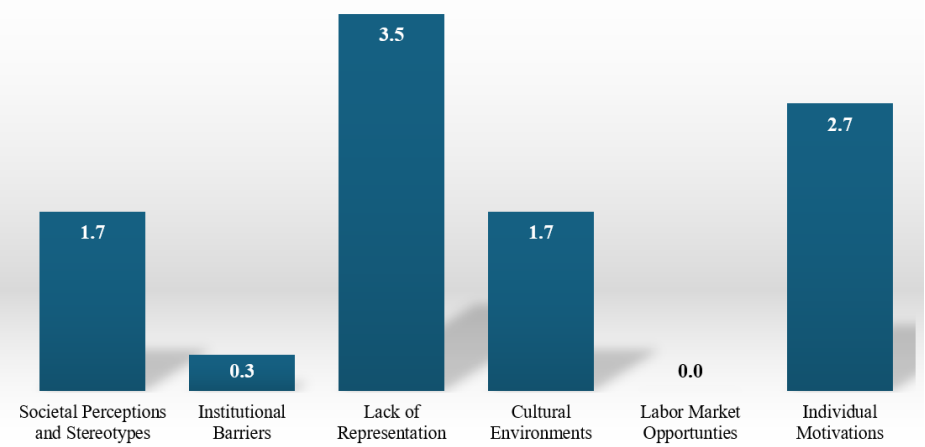

Figure 3. Analysis of Gender Disparities: A Comparative Study

A summary of key findings from small focus group interviews is presented in Table 1.

Table 1. Summary of Key Findings from Small Focus Group Interviews

Key Aspects	Findings
1. Influences on Decision to Pursue CEM	• Exposure to CEM through high school trade programs and media like the HGTV show "Fixer Upper" influenced some participants to pursue CEM during their junior or senior years of high school. • Family members' occupations in construction-related fields also played a role in influencing participants' decisions to pursue CEM.
2. Perceptions of Gender Diversity	• While some participants reported a positive experience within the CEM program, others highlighted a low gender diversity, with instances of being among very few female students or the only female in their classes.
3. Perceptions of Gender Representation in the Construction Industry	• Some participants noted a positive trend of increasing female presence and acceptance in the construction industry based on personal experiences, feeling respected and accepted by male colleagues. • Conversely, others emphasized the lack of female representation in the construction industry, experiencing instances of being the only woman on jobsites and concerns about not receiving respect from male counterparts.
4. Awareness of Diversity Initiatives in the Industry	• Participants highlighted the importance of raising awareness about construction careers, especially among females, and suggested making information about the industry more accessible to encourage more women to pursue careers in construction.
5. Recommendations for Encouraging Female Enrollment in CEM	• Suggestions included promoting various career paths within the CEM degree, highlighting successful women in the industry, having more successful women in the industry speak at events, and organizing events specifically aimed at promoting gender diversity in non-traditional majors for women.

Discussions

The study conducted small focus group interviews to explore the multifaceted factors influencing female students' enrollment in CEM programs. It revealed diverse perspectives on the factors

shaping female students' decisions to pursue CEM degrees and highlighted potential strategies to encourage greater gender diversity in the field.

Key findings from the study suggest that representations of successful women professionals in the construction industry and individual motivations regarding construction and career opportunities significantly impact female students' decisions to major in CEM. Participants emphasized the importance of exposure to successful women role models in the industry and their own personal motivations in choosing CEM as a major field of study.

Based on these findings, the study offers actionable recommendations for CEM program recruitment efforts. These include collaborating with Professional Women in Construction chapters to provide networking opportunities and mentorship programs, utilizing social media and internet platforms to showcase the achievements of women in the construction industry, featuring female guest speakers to inspire prospective students, and providing comprehensive information about possible career paths with a CEM degree to high school female students and counselors.

Furthermore, the study underscores the importance of addressing gender imbalance in CEM programs and offers actionable insights to promote gender diversity and inclusion in the construction industry. By implementing these recommendations, educational institutions can work towards creating more inclusive and diverse learning environments in CEM education and ultimately contribute to a more equitable representation of women in the construction industry.

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