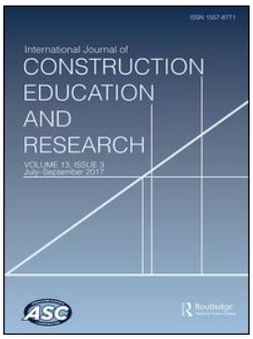

International Journal of Construction Education and Research

ISSN: 1557-8771 (Print) 1550-3984 (Online) Journal homepage: www.tandfonline.com/journals/uice20

An Evaluation of Factors for Retaining Female Students in Construction Management Programs

Ben F. Bigelow, David Bilbo, Lisa Ritter, Minna Mathew & Jonathan W. Elliott

To cite this article: Ben F. Bigelow, David Bilbo, Lisa Ritter, Minna Mathew & Jonathan W. Elliott (2016) An Evaluation of Factors for Retaining Female Students in Construction Management Programs, International Journal of Construction Education and Research, 12:1, 18-36, DOI: 10.1080/15578771.2015.1085927

To link to this article: https://doi.org/10.1080/15578771.2015.1085927

INTERNATIONAL JOURNAL OF CONSTRUCTION EDUCATION AND RESEARCH
2016, VOL. 12, NO. 1, 18–36
http://dx.doi.org/10.1080/15578771.2015.1085927

Routledge
Taylor & Francis Group

An Evaluation of Factors for Retaining Female Students in Construction Management Programs

Ben F. Bigelow, Ph.D.[a], David Bilbo, D.Ed.[a], Lisa Ritter, M.S.C.M.[a], Minna Mathew, M.S.C.M.[a] and Jonathan W. Elliott, Ph.D.[b]

[a]Texas A&M University, College Station, Texas, USA; [b]Colorado State University, Fort Collins, Colorado, USA

ABSTRACT

The under-representation of women in construction necessitates academia's understanding of what influences a female's decision to remain in a construction management (CM) program. Many factors that retain women in CM programs have been identified. Understanding which of these factors are most influential is an important step towards increasing the number of women in CM. This study used a quantitative approach to explore the factors that have been previously identified to retain female students in CM programs; however, qualitative methods were also used to identify additional retention factors. The research was completed through a self-administered, researcher-designed survey of female CM students at five major universities. The results provide a prioritized ranking of the factors identified to retain female students. They indicated that the most positively influential factors for females to remain in a CM undergraduate degree program are: the community of students, lab classes, internships, innovation in the classroom, and student organizations. Job/Career opportunities also emerged as a positively influential factor for retention of female students that was previously not identified in the literature.

KEYWORDS

Construction education; internships; mentoring; retention; women in construction

Introduction

Construction represents a growing industry in the United States with an ever-increasing demand for a knowledgeable, professional workforce. As demand increases, without an increase in the supply of workers, the industry must seek new avenues to recruit and fill unmet demand (Menches & Abraham, 2007). One of the largest underrepresented labor resources in construction is women. There are 813,000 construction managers in the United States and only about 60,000 (7.3%) are women (BLS, 2014b). Not surprisingly, women are also significantly underrepresented in undergraduate construction management (CM) programs (Sewalk & Nietfeld, 2013). According to the Bureau of Labor Statistics (BLS, 2014a) "Employment of construction managers is projected to grow 16% from 2012 to 2022" and "Those with a bachelor's degree in a CM or related program, coupled with construction experience, will have the best job prospects." To increase the number of women in the construction industry, there should first be an increase in women earning CM degrees.

CONTACT Ben F. Bigelow bbigelow@arch.tamu.edu Texas A&M University, 3137 TAMU, College Station, TX 77843, USA.

Factors previously identified to attract women to CM degree programs have been considered. Among the many factors reported, it was found that internships, awareness of career opportunities, fathers taking daughters to work, having a father in the industry, and non-internship work experience were the most positively influential factors (Bigelow, Bilbo, Matthew, Ritter, & Elliott, 2015). Since the best methods for attracting female students has been investigated, this research focused on how to most effectively retain female students in CM degree programs.

Previous studies on retention of female students have identified a substantial list of influential factors. This study sought to understand which of those factors were the most effective for current female students. Understanding the most influential factors in retaining female students should help colleges and universities provide appropriate and effective support for female CM students. Increasing the number of females who complete CM degrees supports the ultimate goal of growing the number of knowledgeable, skilled and professional female managers in the construction industry.

Previous research has identified and established the challenges faced in retaining female students, and the numerous contributing factors. However, with many retention factors identified, a CM program is left to guess which factors will have the greatest influence, as they determine where best to focus their retention efforts. Therefore, the focus of this study is not the problem of retention, but rather what retention strategies are most effective. Specifically, this study sought to identify the factors, reported by previous research, that retain female CM students, and then to analyze those factors to determine which have the strongest positive influence on female students continuing their CM educations. The resultant research questions for this study were:

1. What are the factors (identified in the literature) that help to retain female CM students?
2. Which factors most influence students' decision to remain in a CM undergraduate degree?
3. Is there a difference in the factors that influence a transfer or change of major student compared with students who have remained at the same school in the same program?
4. Is there a difference in the factors that influence lower level (freshman & sophomores) students and upper level (junior and seniors) students?

This study provides colleges and universities with an understanding of the factors that female students perceive as having the greatest positive influence on them remaining in a CM degree program. Understanding of the factors which most positively influence in a female's decision to remain in the CM degree should help colleges and universities ensure they are part of the student's experience while enrolled in a CM degree program.

Review of literature

The underrepresentation of women in the construction industry has been consistent for decades and is not only a problem in the United States. The United Kingdom, Australia, Japan, and Canada all face similar situations (Menches & Abraham, 2007). In the United Kingdom in 1988, women represented only 7% of the construction workforce (Gale,

1994). In Alberta, Canada, although the Construction industry represented the region's third largest industry, women represented only 14% of the workforce (Alberta Innovation, n.d.). According to the Bureau of Labor Statistics in 2013, 7.3% of construction managers are women (BLS, 2014b). The National Association of Women in Construction (NAWIC) (2012) reported that as of December 31, 2011, there were 828,000 women employed in the construction industry (workforce and management) which equates to approximately 9% of the industry.

The United States, Canada, and the United Kingdom all have begun construction industry initiatives to increase the recruitment of women and other underrepresented minorities (Menches & Abraham, 2007). Canada sought to improve the work-life balance of the construction industry and developed mentoring programs to support women and other minority groups working there (Alberta Innovation, n.d.). The United Kingdom created the Construction Industry Training Board (CITB) in 2006 to assist in providing apprenticeships and other training resources to entry-level workers (Menches & Abraham, 2007). The recognition that women needed additional support in the construction industry in the United States began decades ago, illustrated by the creation of the National Association of Women in Construction (NAWIC), which gained national charter in 1955 (NAWIC, 2012). The sole purpose of the organization was to create a support network for women in the male-dominated construction industry and to encourage their advancement in the field. In 1980, the Professional Women in Construction (PWC) non-profit was started with a similar purpose of supporting and advancing the careers of women in construction and related industries (About PWC, 2013).

Despite these efforts women remain underrepresented in the construction industry. Underrepresentation of women in construction is unlikely to be the result of gender wage disparity as the gender wage gap in construction is the second smallest of any industry (Bilbo, Bigelow, Rybkowski, Kamranzadeh, 2014). Arditi and Balci (2009) found that women are underrepresented in construction due to its culture, the nature of the work, and the project-based setup. CH2M HILL's Women's Leadership Initiative however has proven that these challenges are not insurmountable. The Women's Leadership Initiative set out in 2003 to attract, develop, retain, and promote women into leadership positions. From 2003 to 2008, women's representation in senior leadership positions at CH2M HILL increased from 2.9% to 18% and women project managers grew from 20.5% to 30.3%.

Sewalk and Nietfeld (2013) found positive correlations between women's enrollment in CM programs and several other factors; specifically, having female faculty and female support/social groups. Moore and Gloeckner (2007) identified three keys to retaining female's in CM, both through school and then into their career; 1) be honest about the challenging culture women face, 2) develop a mentoring program, and 3) incorporate internships or other work experience into the program.

Once female students are in a construction-related program the question becomes, how are they retained? In many cases the same factors used to attract female students are also effective for retaining them. Midwestern University has implemented several programs to increase the female students' integration into the program as well as develop their identity in a male-dominated industry; programs include socials, faculty mentoring, networking through NAWIC, and job site visits (Shane, Lopez Del Puerto, Strong, Mauro, & Wiley-Jones, 2012). This is consistent with Moore's finding that networking and social integration were key in a female's success (Moore, 2006).

Table 1. Factors identified for remaining in CM degree program.

#	Factor	Source
1	Internship after enrolling in the construction related degree	Moore & Gloeckner, 2007
2	Non-Internship construction work experience after enrolling in college	Moore & Gloeckner, 2007
3	In-classroom innovation in construction classes (use of videos, gadgets etc)	Knight et al., 2011
4	Mentoring	Shane, Lopez Del Puerto, Strong, Mauro, & Wiley-Jones, 2012; Moore & Gloeckner, 2007
5	Tutoring	Fox, Sonnert, & Nikiforova, 2011; Tsui, 2007
6	Workshops and Seminars	Tsui, 2007
7	Scholarships and Fellowships	Fielden 2000; Davey 1993
8	Individual involvement in construction-related research	Fox et al., 2011; Tsui, 2007
9	Faculty members of your gender	Sewalk & Nietfeld, 2013; Shane et al., 2012; Lopez del Porto et al., 2011; Moore, 2006; Sewalk & Nietfeld, 2013; Shane et al., 2012
10	Students of your gender in the program	Milgram, 2011
11	Involvement in construction related student organizations	Shane et al., 2012; Moore, 2006
12	Hands on experience in construction lab classes	Fox et al., 2011; Knight et al., 2011
13	Community of construction students/ classmates	Shane et al., 2012
14	Academic advising	Fox et al., 2011; Knight et al., 2011
15	Courses based on mathematical analysis (e.g., structures, estimating)	Moore, 2006

Although existing literature has identified various factors for retaining female students, to date there has not been research to learn the perceptions of female students regarding these factors. Table 1 displays these factors and their sources. This study evaluated female student's perceptions on the influence of these factors on their continued pursuit of a CM degree.

Methodology

To assess female student perceptions of factors positively influencing their retention in undergraduate CM degree programs, a self-administered, researcher-designed survey was used. The survey was developed using retention factors previously identified in existing literature. Survey participants included students in the CM programs at Arizona State University (ASU), Auburn University (AU), Colorado State University (CSU), Purdue University (PU), and Texas A&M University (TAMU). These universities were selected as they are five of the largest CM programs in the United States. All of which had enrollment in excess of 340 total students in their CM degree program and at least 5% female enrollment at the time of this study.

The total female enrollment at the schools selected was 172, from which 97 responses were obtained and after pairwise deletion the actual sample consisted of 84 usable responses, producing a 49% response rate. At TAMU and CSU surveys were administered in person, while students from ASU, AU, and PU completed the survey online via Qualtrics (Provo, Utah). A larger portion of the sample was expected to come from the schools were data were collected in person. While this was true for TAMU, CSU did not return a higher number of responses. Table 2 displays the breakdown of the sample

Table 2. Population, sample, and response rates.

University	Total CM enrollment	Female enrollment	% Female in program	*n*	% of Sample	Response rate
ASU	345	33	9.6%	10	12%	30%
AU	347	25	7.2%	14	16%	56%
CSU	506	29	5.7%	11	13%	38%
PU	356	27	7.6%	8	9%	30%
TAMU	680	58	8.5%	42	49%	72%
Total		170		85		

compared to the population, and the response rates. All data were collected in the Spring of 2014, and human subjects approval was obtained prior to commencing data collection.

The sample is considered externally valid because it is representative of the population (Gliner, Morgan, & Leech, 2009); the researchers conclude representativeness based on the response rates. At 30%, ASU and PU were the lowest, but still quite good, and the remaining school's response rates increased from there. Although TAMU represents the largest portion of the sample potentially skewing the results, a portion of their higher participation can be explained by TAMU having the largest total enrollment and the second highest percentage of female students, making their female enrollment 45% to 55% higher than the other schools.

The 15 factors gathered from previous research reported to retain female CM students include: Internships, Non-Internship work experience, In-Classroom innovation, Mentoring, Tutoring, Workshops & Seminars, Scholarships & Fellowships, Involvement in research, Faculty members of your gender, Involvement in student organizations, Construction lab classes, The community of students, Academic advising, and Mathematical analysis. Table 1 displays these factors and their sources. Students were also asked open-ended questions to identify any additional retention factors not already found in the literature.

The researcher-designed survey asked participants to rate each factor's level of influence on a 5-point Likert scale to investigate which factors most positively influenced a student's decision to remain in a CM degree program. The Likert scale items were: 1 = Highly Positive, 2 = Slightly Positive, 3 = No Influence, 4 = Slightly Negative, 5 = Highly Negative, and Not Applicable. The scale enabled the calculation of a mean, where the lower the mean the more positively influential the factor. Because all of the factors had been identified in the literature as positively influential in retaining female students, it was expected that all factors would produce a mean less than 3. Means closer to 1 indicate stronger perceptions of positive influence.

To improve internal validity, the survey went through two different focus groups prior to data collection. Female CM students from TAMU made up the focus groups, which consisted of seven and eight students, respectively. In the focus groups participants took the survey and afterwards the researchers led a discussion with the participants to identify weaknesses in the survey. After the completion of each focus group session, the researchers revised the survey based on the feedback received. Focus group data were not included in the final data set.

The researchers planned to exclude the "Not Applicable" responses from the mean calculation; however, investigation of the responses revealed inconsistencies. For example, regarding internships, 14 students indicated that internships were "Not Applicable." However, 11 of them came from schools which require students to complete an

internship. Because of this potential confusion on the part of the participants, means were calculated combining the "Not Applicable" responses and the "No Influence" responses, giving them both a value of 3 in the mean calculation.

Descriptive statistics were the primary method of data analysis used in the study. However some analytical statistics were also used to compare the transfer and non-transfer student groups and lower- and upper-level students. Because of the open-ended responses, qualitative data coding was also employed to search for any themes present.

Results and discussion

Sample description

The purpose of this study was to identify and analyze the factors that most influence female students to remain in a CM program. Participants came from all socioeconomic statuses, but the grand majority (90%) of students identified somewhere between "lower middle class" and "upper middle class." As might be expected only a small percent (3% and 5%, respectively) identified with an "upper class" or "lower class" background. This finding is consistent with Moore's (2006) finding that the majority of females in CM come from middle class families. The self-reported socioeconomic status of the sample is displayed in Figure 1.

In the sample 93% anticipated going to work in the construction industry after graduation. Of the remaining students, three did not respond, and only three indicated they did not anticipate working in the construction industry after graduation. The majority of female students (68%) plan to work in the commercial construction industry segment. Figure 2 displays the student's industry segment preferences. Just over half (52%) indicated they hoped to work in the field while the rest hoped to work in an office.

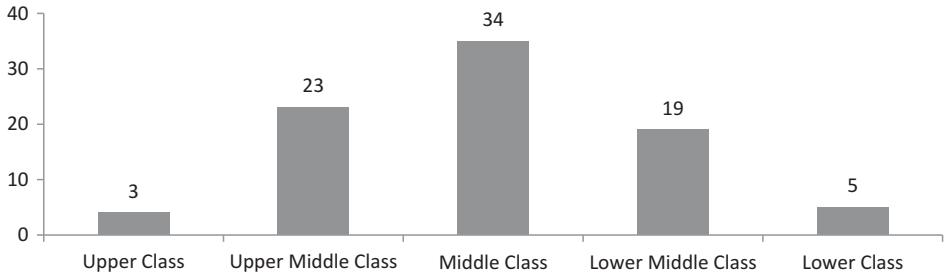

Figure 1. Participant self-reported socio-economic status.

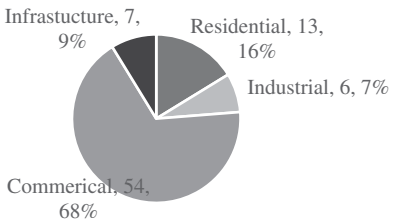

Figure 2. Industry sector preference (*n*=80).

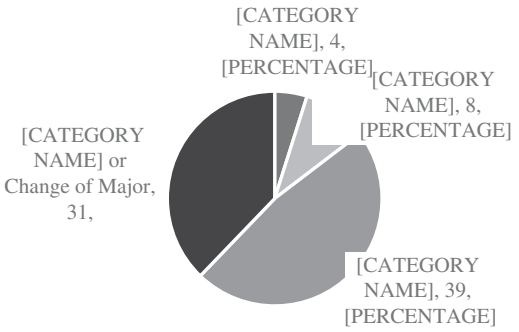

Figure 3. Transfer or change of major (*n*=82).

While approximately 15% of students were transfer students, the largest portion (47%) were change of major students at their current school. As seen in Figure 3, approximately 38% of respondents indicated they were neither transfer nor change of major students.

Individual retention factor results

Table 3 displays the results of the mean calculation. As expected none of the factors returned a mean greater than 3, validating the literature that all of these factors should be considered a positive influence on female student retention. But, there were some individual negative responses. The instances of negative responses are displayed in Figure 4. A single negative response is inadequate to draw a negative conclusion about that factor, but larger numbers of negative responses bear consideration. To appropriately consider the factors with multiple negative responses, and because the calculated mean does not effectively tell the whole story of each factor, an individual discussion of the results for each is presented next.

Table 3. Means of factors evaluated (*n* = 84).

Factor	Rank	Mean	SD
Community of Students	1	1.45	.661
Construction Lab Classes	2	1.49	.61
In-Classroom Innovation	3	1.6	.709
Internship	4	1.61	.677
Involvement in Student Organizations	5	1.74	.744
Scholarships and Fellowships	6	1.8	.705
Academic Advising	7	1.96	.854
Students of Your Gender	8	2	.962
Faculty of Your Gender	9	2.07	.986
Mentoring	10	2.11	.886
Workshops and Seminars	11*	2.13	.759
Mathematical Analysis	11*	2.13	1.002
Non-internship Work Experience	12	2.2	.965
Involvement in Research	13	2.26	.93
Tutoring	14	2.54	0810

*Identical rank and mean.

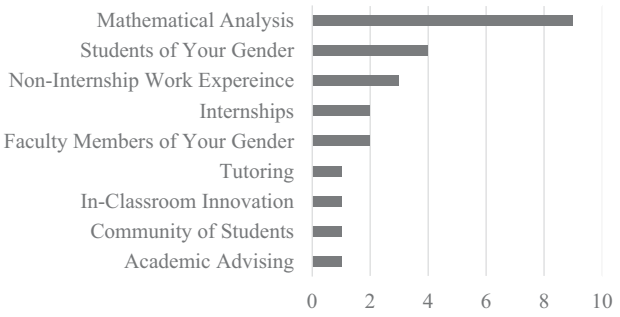

Figure 4. Factors with negative responses.

Community of students

With 75 (89%) of the participants reporting that the community of students was a positive influence, this factor ranked as the most influential factors for retaining female students in CM degree programs based on the study's mean calculation. Figure 5 displays the responses for this factor. There was one "Slightly Negative" response, but the positive influence reported by so many students suggests that the negative response is an aberration among female CM students and the communities they form. The three "Not Applicable" responses are a bit perplexing, as all students interact with the community of students they are inherently a part of, as students in a traditional degree program. This factor's many positive responses (74) led to its result as the most positively influential factor. The strong positive influence of this factor is particularly interesting given that it was only identified in one previous study (Shane et al., 2012). The challenge with this factor, is finding tangible ways to positively influence the sense of community established by the students in their program.

Construction lab classes

Construction lab classes represent a factor that can be pursued with confidence in retaining female CM students, 82% responded that this factor positively influenced them to remain, and had no negative responses (Figure 6). Hands on instruction in construction lab classes is particularly important as this factor can actively be managed by a CM

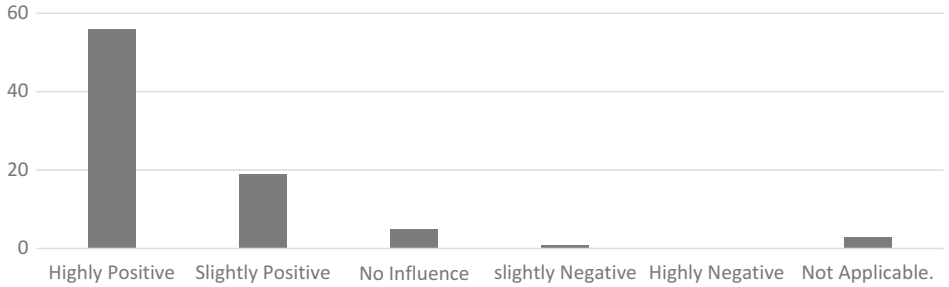

Figure 5. Community of students, participant responses.

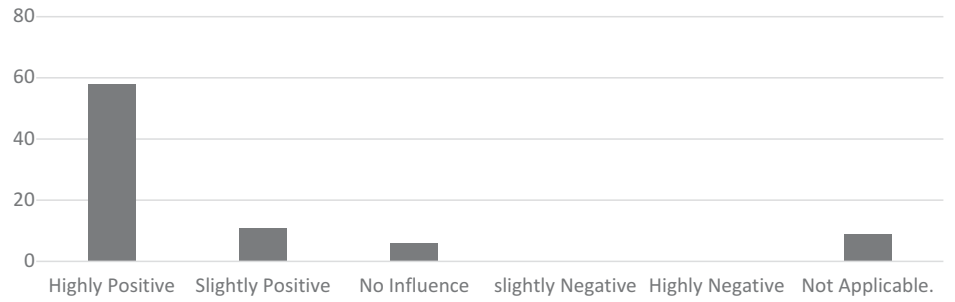

Figure 6. Construction lab classes, participant responses.

program to retain female students. Further with the highest number of highly positive responses, 58 (69%), and no negative responses, this factor has a solid argument to be the most positively influential factor in retaining female students in CM degree programs.

In-Classroom innovation

In-Classroom Innovation was defined by Knight (2011) as the use of videos, gadgets, etc. in the classroom. This factor's total positive response was 89%, suggesting that in-classroom innovation is a highly positive influence. A small number of students (8) indicated in-classroom innovation was not applicable or had no influence on them, and one reported a negative influence, but the total positive responses (75) indicate the positive effect of this factor in retaining female CM students. Like lab classes this factor is notable as it can be easily implemented in a CM program. Results for this factor are displayed in Figure 7.

Internships

Internships had the second highest frequency (57) of "Highly Positive" responses. Indicating this factor is another very important retention factor female students. As can be seen in Figure 8, internships had an interesting result pattern with 17 "Not Applicable" responses. These were treated as "No Influence" responses since 14 of the students who responded "Not Applicable" came from schools that require internships as part of their

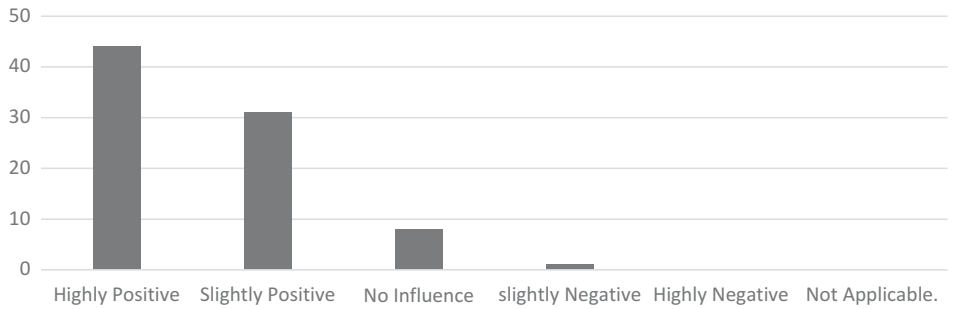

Figure 7. In-Classroom Innovation, participant responses.

degree plan. Internships also netted two slightly negative responses which suggest the well documented barriers to female participation in the construction industry may also reach interns. However, only two reported negative influences, may indicate that the industry is overcoming some of the challenges women have historically faced working in construction, or that those barriers were not issues for interns. With so many "Highly Positive" responses (57), internships are certainly a solid strategy for retaining female CM Students, and support Moore and Gloeckner's (2007) conclusions of the same.

Involvement in student organizations

Involvement in student organizations was one of six factors that returned no negative responses. Nearly 79% reported it as a positive influence, with the balance indicating it was "No Influence" or "Not Applicable." Figure 9 displays the split between highly positive (40) and slightly positive responses (26). According to the calculated mean, involvement in student organizations is less influential than some other factors in retaining female CM students. However, it is clearly a solid strategy for retaining female students and is a logical contributor to the "Community of Students" factor.

Scholarships & fellowships

Approximately 74% of participants indicated scholarships and fellowships were a positive influence (Figure 10). While 22 responded that they had "No Influence" or were "Not

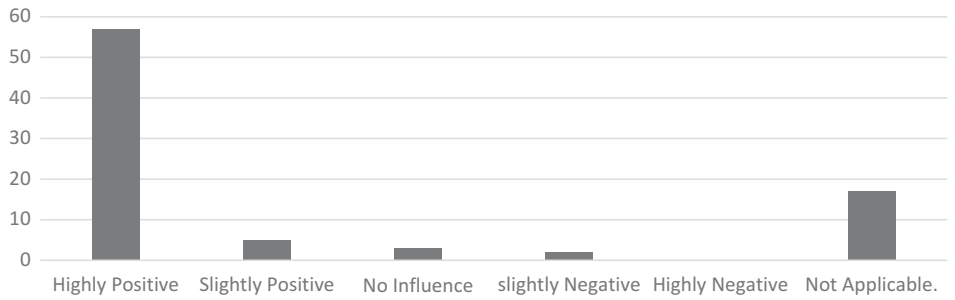

Figure 8. Internship, participant responses.

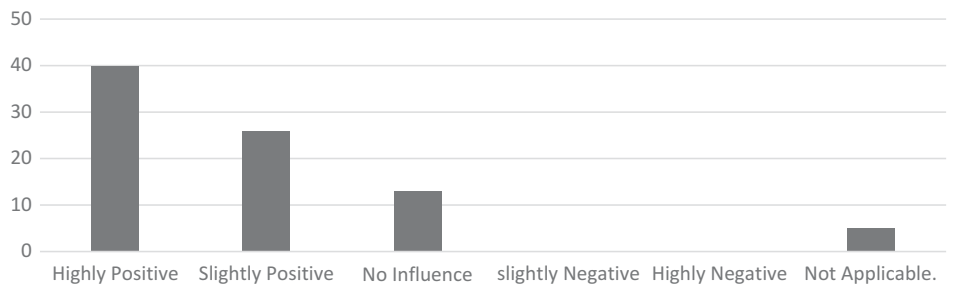

Figure 9. Involvement in student organizations, participant responses.

Applicable," there were no negative responses. So while this factor did not impact some students, it was a positive influence for all others.

Academic advising

The majority of female students (70%) indicated that academic advising had a positive influence on them remaining in a CM program. However, a shift in the responses was observed when compared to previous factors (Figure 11). The number of "No Influence" or "Not Applicable" responses are much higher (24), and there is almost no difference in "Highly Positive" responses (30) and "Slightly Positive" responses (29). These shifts suggest that while this factor is positive the effect is less strong, and that it is occurring within a smaller portion of female CM students. Although these shifts in responses represent a decline from the factors already presented, it is still a positive influence.

Students of your gender

Students of your gender were expected to be a very influential factor in retaining female students, because of the friendships that frequently form between students. The results (Figure 12) indicate that for many students (67%) relationships with other female students are positively influential, however, the high number of "No Influence" and "Not Applicable" responses (24) were observed. In was also noted that the number of negative responses (4) may indicate more complexity in this factor; this finding represents an opportunity for further research.

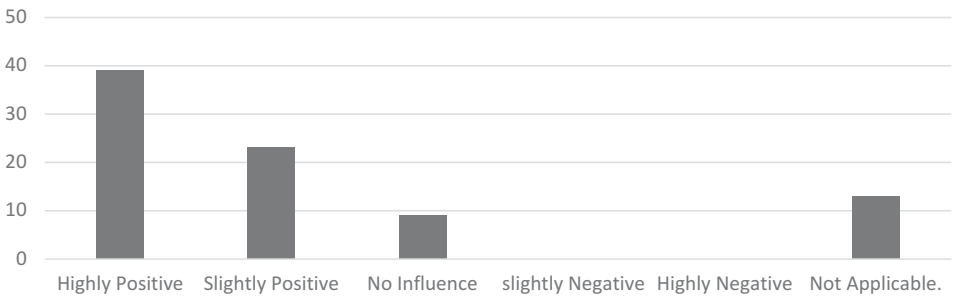

Figure 10. Scholarships & fellowships, participant responses.

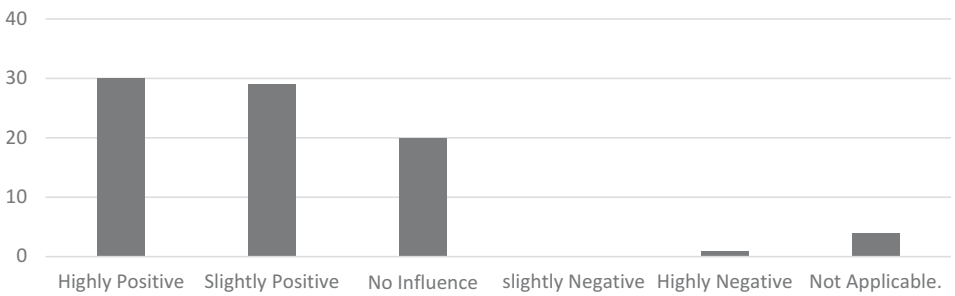

Figure 11. Academic advising, participant responses.

Faculty of your gender

Faculty of your gender was identified by six different articles in the literature review for retaining female students, making it the most strongly supported among the 15 factors identified. However, the results of this study were not as strong as would be expected given its support in the literature. As can be seen in Figure 13, the portion of students who reported that this factor was either "Not Applicable" or "No Influence" was large at 42%. Female faculty members were a positive influence for 56% of the female students. From a practical perspective however, with 44% indicating otherwise a large portion of female students are not influenced by this factor.

Mentoring

Mentoring is broadly supported as a retention strategy in many disciplines. Mentoring had no negative responses, but like faculty of your gender, it appears that mentoring does not reach a large portion of female students. Just over half (51%) of the female students indicated that mentoring was a positively influential factor (Figure 14), and 31 responses were "Highly Positive." Mentoring has a strong positive influence for the students it reaches, but it simply does not get to many students.

Workshops and seminars

Workshops and seminars represent a marked shift in the identified factors for retaining female students. This was the first factor which has a greater number of "Slightly Positive"

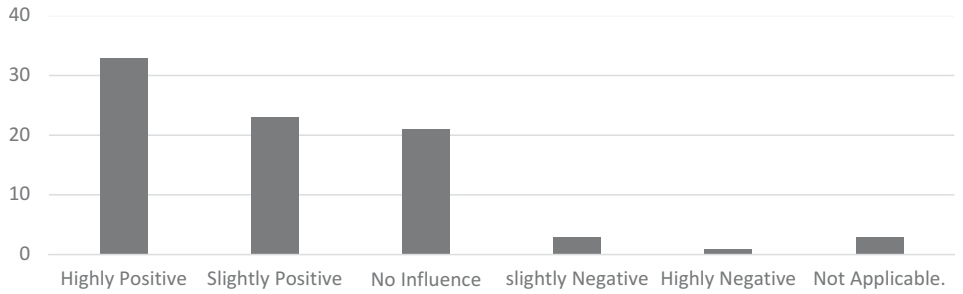

Figure 12. Students of your gender, participant responses.

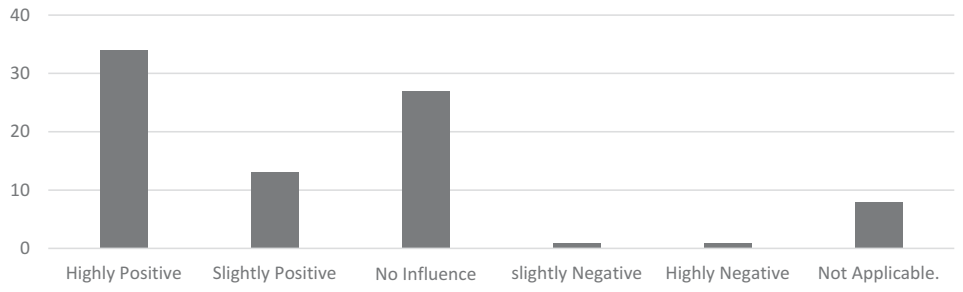

Figure 13. Faculty members of your gender, participant responses.

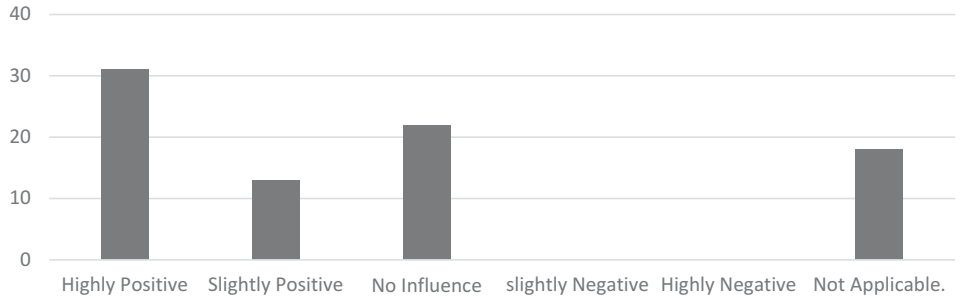

Figure 14. Mentoring, participant responses.

responses (29) than "Highly Positive" responses (22). This shift is significant as it distinguishes the reduced effectiveness of this factor (Figure 15). With 38 "No Influence" and "Not Applicable" responses (40%) there is a large portion of female students who are simply not exposed to these factors. This does not diminish their positive influence, but the results are telling in the ability of these factors to reach a high percentage of female students.

Mathematical analysis

Mathematical analysis received the highest number of negative responses of any factor in the survey (11). Despite the negative responses, it was not the lowest ranking factor. With 68% of respondents indicating it was positively influential, the authors confirm that classes with an emphasis in mathematics can influence female students to remain in a CM degree program. As seen in Figure 16, the number of "Slightly Positive" responses (31) were greater than the "Highly Positive" responses (26). Mathematical analysis can retain female students, but even without the negative influences reported, there are a number of factors for retaining female students that are more positively influential, and that do not have the potential for negative influence found in this factor.

Non-internship work experience

Despite three negative responses, non-internship work experience had a strong "Highly Positive" response rate (27). As can be seen in Figure 17, more than half of respondents

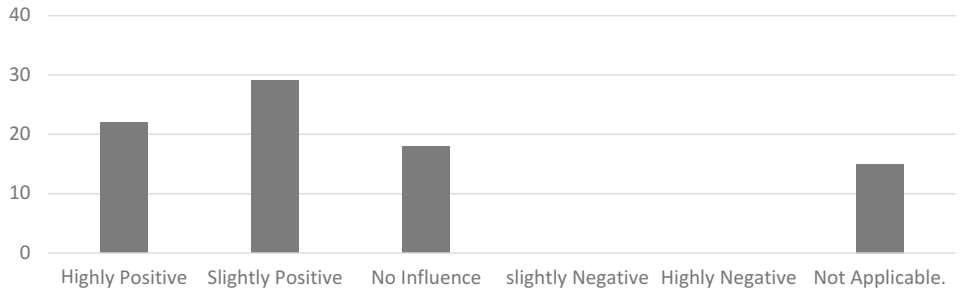

Figure 15. Workshops and seminars, participant responses.

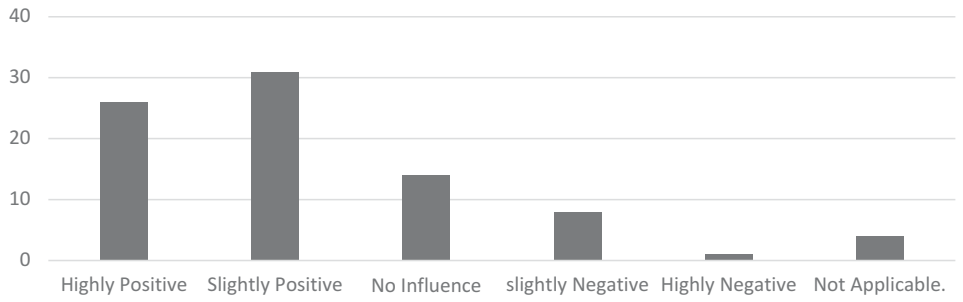

Figure 16. Mathematical analysis, participant responses.

(52%) indicated this is a positively influential factor. However, with more "Not Applicable" responses (25) than any other factor, non-internship work experience has a higher mean in the calculation used for this study. This factor has a more positive influence on female students than its ranking indicates (13 out of 15), but like other factors already discussed, it is simply not reaching many female students.

Involvement in research

As Figure 18 shows, involvement in research had no negative responses and 27 "Highly Positive" responses. But, with more than half of respondents (58%) indicating that it had "No Influence" or was "Not Applicable" it is not reaching or impacting most female students. Research is a requirement for most tenure or tenure track faculty members so this factor may represent an untapped resource for retention and research productivity.

Tutoring

Figure 19 shows why tutoring is at the very end of the list of factors for retaining female students. Well over half 55 (65%) indicated tutoring had "no influence" or was "not applicable." Tutoring does not reach or does not matter for most female students, and while there were 28 positive responses, more "Slightly Positive" than "Highly Positive" responses further suggests that this factor while positive overall, is a less effective strategy for retention of female CM students.

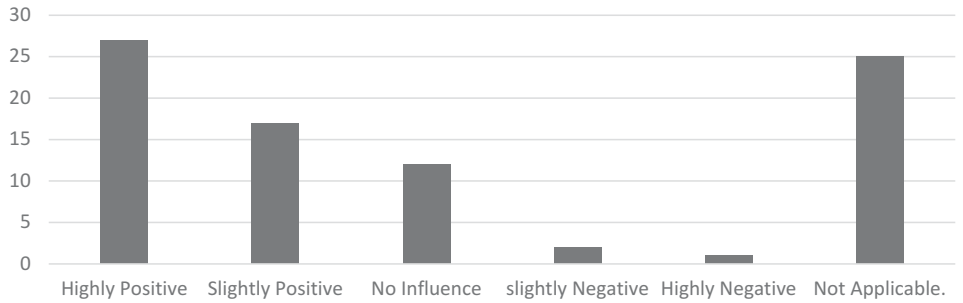

Figure 17. Non-internship work experience, participant responses.

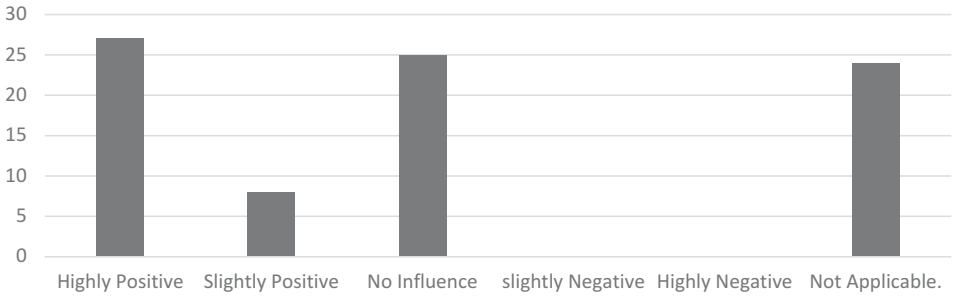

Figure 18. Involvement in Research, participant responses.

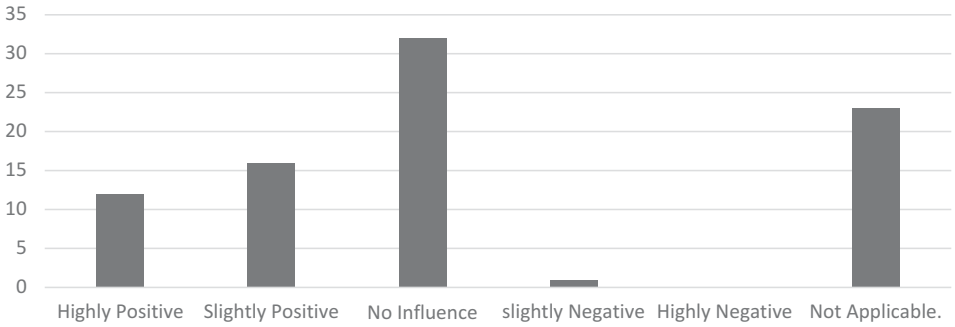

Figure 19. Tutoring Participant Responses.

Factors for transfer vs. non-transfer students

This research also sought to determine whether the factors reported to retain female students differed between transfer and non-transfer students. Because the dependent variables were ordinal and the variances were unequal, Mann-Whitney U-tests were performed to compare the students. Of the 15 retention factors four had a statistically significant difference in their influence on transfer students vs. non-transfer students. The 51 transfer students had significantly higher mean ranks than the 31 non-transfer students regarding mentors, scholarships and fellowships, student organizations, and faculty of your gender retention factors—indicating that these factors are more positively influential for non-transfer students than for transfer or change of major students. Table 4 displays the specific results of this statistical analysis.

The positive influences of most of the retention factors are consistent between transfer or change of major and non-transfer students. However, for non-transfer

Table 4. Mann-Whitney U-test significant results based on transfer status.

Factor	Non-transfer mean rank	Transfer mean rank	*U*	*p*	*R*
Mentors	34.45	45.78	*572*	*.030*	*–.240*
Scholarships & Fellowships	34.61	45.69	*577*	*.030*	*–.240*
Student Organizations	35.15	45.36	*593.5*	*.041*	*–.225*
Female Faculty	32.10	47.22	*499*	*.003*	*–.324*

students; mentors, scholarships, student organizations, and especially female faculty are more positively influential in their decision to remain in a CM degree program. This result regarding female faculty is of note as it provides context to the results of this study when compared to the considerable support in the literature for female faculty as a retention strategy. Among female non-transfer students, these factors are more positively influential than the ranking from an aggregated mean implies.

Factors for upper- and lower-level students

To further explore how the different retention factors might affect different groups of students, the sample was also analyzed based on student classification. Again because the dependent variables were ordinal and the variances unequal, Mann-Whitney U-tests were performed to compare the 32 Freshmen and Sophomores (lower-level students) to the 52 Juniors and Seniors (upper-level students). Four of the 15 retention factors had significant differences based on the student classifications. In this case, workshops and seminars and female faculty were more positively influential for underclass students, while internships and the community of students were more positively influential for upper-level students. Detailed results can be seen in Table 5.

These results, combined with those comparing transfer students and non-transfer students, indicate that the support for female faculty as a retention factor is more positively influential than the aggregated data from this study suggests. For both upper-level and non-transfer female CM students, faculty of their gender is a more important positively influential retention factor.

New factors identified

In addition to the factors that were specifically identified in the literature and reported above, this study also asked students to report any other factors that have positively influenced them to remain in their CM program. Of the participants, 50 answered this question, resulting in 66 different responses. Following filtering 45 responses remained and eight unique themes emerged. As can been seen in Table 6, two of these themes are well supported by the number of responses, and should be included as factors that positively influence female students to remain in CM degree programs. The other themes however, require additional research to support them as factors for retaining female CM students. The authors emphasize the lack of responses needed to report most of these as factors for retention of female CM students, they are all shown in Table 6 for information purposes only.

Table 5. Mann-Whitney U-test significant results based on student classification.

Factor	Upper level mean rank	Lower level mean rank	*U*	*p*	*R*
Workshops & Seminars	46.57	35.89	*620.50*	*.043*	*−.220*
Female Faculty	46.59	35.86	*619.50*	*.039*	*−.226*
Internships	38.89	48.36	*644.50*	*.036*	*−.229*
Community of Students	37.85	50.06	*590.00*	*.007*	*−.292*

Table 6. Additional factors for retention of female students identified.

Theme/Factor	Responses
Job/Career opportunities	17
Enjoyment/passion for construction	17
Professors/faculty	4
Lack of women in construction	2
Courses offered	1
Guest speakers	1
Advances in technology	1
Real world application	1

With about 20% (17 of 84) of participants independently providing an open-ended response indicating job/career opportunities as a factor that retains female CM students, it is surprising that it was not found in the literature. These results clearly indicate however that job and career opportunities are a factor in female CM student retention. Based on this result and those relating to internships, the authors assert that a robust relationship between CM programs and the construction industry indirectly contribute to female student retention. Further the industry relationships that lead to these factors should be an important focus of retention efforts.

Like job/career opportunities, enjoyment/passion for construction also netted 17 responses. This finding is interesting as it indicates that simply the subject matter of construction management can be an effective factor in retaining some female students once they are in the program. The data does not reveal if this sentiment evolved after the student started their CM program or if they came in with a passion for construction. This factor is not one that can readily be managed by a CM department, however further study to understand it could reveal more tangible opportunities for its use in retaining female students.

Conclusions

This research represented female student's perception of factors positively influencing their continued pursuit of a CM degree at five large universities in the United States. It is noted that the sample is slightly skewed in that students from TAMU represent the largest proportion of the sample. Further this research only represents a moment in time (Spring 2014) and as such generalizations should be drawn with caution. The mean formula also placed some factors, such as mentoring, and non-internship work experience, lower on the list because fewer female students had experience with them, not because they were negative influencers. The factors at the top of the list are those that have the strongest positive influence on the most female CM students.

This research supports the existing literature on factors that retain female students in CM programs. All of the 15 factors identified from the literature were perceived as positively influential for current female CM students. With the exception of mathematical analysis, the factors identified can confidently be used in strategies to retain female students. For mathematical analysis however, there is a risk of negative influence. Beyond the positive or negative influence, these results also show that many factors are less effective because they do not reach, and hence do not influence as many female

students. For CM programs considering where to expend resources, factors with both a positive influence and broad coverage should be targeted.

Since some factors were shown to be more positively influential than others, understanding which factors will have the most and broadest influence is important. Further it is important to identify among the most positively influential factors those that can be actively managed by a CM program. The results of this study indicate that the community of students was the most effective factor for retaining female CM students, so the allocation of building space to facilitate connections between students and the support of activities that contribute to a sense of community should be valued in considering retention strategies. The importance of the community of students is underscored by the second and fifth factors in the rankings, lab classes and involvement in student organizations. Lab classes allow students to interact with other students at the hands-on level, and involvement with student organizations provide similar opportunities. These factors are especially important pertaining to the community of students as they are tangible and readily manageable by a CM program.

The authors also conclude that strong departmental relationships with industry will contribute to retention of female CM students, as many factors including; internships, scholarships and fellowships, mentoring, non-internship work experience, and career opportunities are facilitated by a strong relationship between CM programs and the construction industry.

This study presents various avenues for future research. Specifically, the researchers recommend inquiry regarding: 1) Further investigation of the community of students factor, to better understand the intricacies of creating a community of students and what contributes to its development. 2) A comparison to male students to learn if the factors that retain male and female students are different. 3) Comparison of current CM students with those who have left a CM program.

References

About PWC. (2013). In *National Association of Professional Women in Construction*. Retrieved October 20, 2013, from http://www.pwcusa.org/v2/about.php?chapter=USA1.

Alberta Innovation and Advanced Education. (n.d.). *A workforce strategy for Alberta's construction industry*. Retrieved from http://eae.alberta.ca/documents/WIA/WIA-BETW_construction_strategy.pdf.

Arditi, D., & Balci, G. (2009). Managerial competencies of female and male construction managers. *Journal of Construction Engineering & Management*, *135*(11), 1275–1278.

Bigelow, B. F., Bilbo, D., Mathew, M., Ritter, L., & Elliott, J. W. (2015). Identifying the most effective factors in attracting female undergraduate students to construction management. *International Journal of Construction Education and Research*, *11*(3), 179–195.

Bilbo, D., Bigelow, B. F., Rybkowski, Z., & Kamranzadeh, A. (2014). Effects of family-related factors on female project managers' salaries in the construction industry in the United States. *International Journal of Construction Education and Research*, *10*(4), 255–267.

Bureau of Labor Statistics (BLS). (2014a). America's young adults at 27: Labor market activity, education, and household composition: Results from a longitudinal study. Retrieved July 25, 2014, from http://www.bls.gov/news.release/pdf/nlsyth.pdf

Bureau of Labor Statistics (BLS). (2014b). *Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity*. Retrieved Oct 28, 2013, from http://www.bls.gov/cps/cpsaat11.pdf

Davey, F. H., & Stoppard, J. M. (1993). Some factors affecting the occupational expectations of female adolescents. *Journal of Vocational Behavior*, *43*, 235–250.

Fielden, S. L., Davidson, M. J., Gale, A. W., & Davey, C. L. (2000). Women in construction: The untapped resource. *Construction Management & Economics*, *18*(1), 113–121.

Fox, M. F., Sonnert, G., & Nikiforova, I. (2011). Programs for undergraduate women in science and engineering issues, problems, and solutions. *Gender & Society*, *25*(5), 589–615.

Gale, A. (1994). Women in non-traditional occupations: the construction industry. *Women In Management Review*, *9*(2), 3–14.

Gliner, J. A, Morgan, G. A., & Leech, N. L. (2009). *Research methods in applied settings: An integrated approach to design and analysis*, (2nd ed.). New York, NY: Routledge.

Knight, D. B., Mappen, E. F., & Knight, S. L. (2011). A review of the literature on increasing the representation of women undergraduates in STEM disciplines through civic engagement pedagogies. *Science Education and Civic Engagement*, *3*(1), 36–47.

Lopez del Puerto, C., Guggemos, A. A., & Shane, J. (2011). Exploration of strategies for attracting and retaining female construction management students. *Proceedings of the 47th ASC Annual International Conference, Lincoln, Nebraska*.

Menches, C. L., & Abraham, D. M. (2007). Women in construction—tapping the untapped resource to meet future demands. *Journal of Construction Engineering & Management*, *133*(9), 701–707.

Milgram, D. (2011). How to recruit women and girls to the science, technology, engineering, and math (STEM) classroom. *Technology and Engineering Teacher*, *71*(3), 4–11.

Moore, J. D. Women in construction management: Creating a theory of career choice and development (Order No. 3226145). Available from ProQuest Dissertations & Theses Global. (305356493) Retrieved from http://lib-ezproxy.tamu.edu:2048/login?url=http://search.proquest.com/docview/305356493?accountid=7082

Moore, J. D. & Gloeckner, G. W. (2007). A theory of women's career choice in construction management: Rrecommendations for academia. *International Journal of Construction Education and Research*, *3*, 123–139.

National Association of Women in Construction (NAWIC) Facts. (2012). In *National Association of Women in Construction*. Retrieved October 20, 2013, from http://www.nawic.org/images/nawic/documents/brochures/factsheet.pdf.

Sewalk, S. & Nietfeld, K. (2013). Barriers preventing women from enrolling in construction management programs. *International Journal of Construction Education and Research*, *9*(4), 239–255.

Shane, J., Lopez Del Puerto, C., Strong, K, Mauro, K., & Wiley-Jones, R. (2012). Retaining women students in a construction engineering undergraduate program by balancing integration and identity in student communities. *International Journal of Construction Education and Research*, *8*(3), 171–185.

Tsui, L. (2007). Effective strategies to increase diversity in STEM fields: a review of the research literature. *Journal of Negro Education*, *76*(4), 555–581.