AC 2011-1027: COMPARING THE LEARNING EXPERIENCES OF MALE AND FEMALE ENGINEERING STUDENTS IN INTERNSHIP AND CO-OPERATIVE EDUCATIONAL OPPORTUNITIES

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Comparing the Learning Experiences of Male and Female Engineering Students in Internship and Cooperative Educational Opportunities

Abstract

Many studies share clear benefits from engineering student involvement in cooperative and internship programs. Students increase in motivation and self-efficacy; they gain specific technical skills as well as improved abilities to apply knowledge, solve problems, and communicate professionally; their improved understanding of the work environment also aids in their career decisions. However, little research has been done to compare these important learning outcomes between male and female engineering students. This study considers research on learning differences between males and females and then looks at how male and female engineering students discuss their co-op and internships experiences. Surveys included both open-ended and likert-scale type questions, with over 200 students responding. Males and females were found to have no difference in overall satisfaction with the cooperative experiences and level of responsibility they were granted. However, females were somewhat less likely than males to say that the experience provided significant engineering training, and they were less likely to say that their mentors were always available for questions. In discussing their learning, females were more likely to cite improved professional communication skills and time management skills, while males were more likely to describe improved technical skills. These findings suggest that students should reflect on what they hope to learn within cooperative experiences in order to find a best fit for them and suggest learning experiences to their mentors. Additionally these findings imply that cooperative program coordinators and mentor engineers should ensure broad based experiences for interns in order to best meet diverse needs and wants.

Key words: cooperative education, internship, gender differences, values, learning

Introduction

Past research shows the value of internships and cooperative learning experiences for undergraduate engineering students. From the perspective of individuals who coordinate internship programs, these experiences motivate students academically and provide them with valuable professional communication skills and an understanding of the engineering workplace (Marshall, 2010; Milliken & Fatehi, 2007). They also help students learn by applying other academic work in real-world settings. Many professional engineers see these learning experiences as one of the most important parts, if not the most important part, of undergraduate education, and say that they should be a requirement (Anderson, et al., 2009). Tener, Winstead, and Smaglik (2001) studied the experiences of 170 construction engineering students. They found that quality internships help students learn how to learn in professional settings, a skill not teachable in the classroom. Laxman, Bright, and Renshaw (2005) reflect on their own experiences as students in internship programs. They note that the internship taught them "to use project development models, learn new technology, and communicate…ideas effectively with management" (p. 1).

At the University of Wisconsin - Madison, we have observed that female engineering students participate in internship and cooperative experiences as frequently as or more frequently

than male students. Furthermore, based on surveys from our College of Engineering career center, each gender equally views these experiences as meeting their expectations. Nevertheless, female engineering students continue to be less likely to go into engineering positions upon graduation than their male counterparts (Takahira, et al., 1998; Wirsbinski, et al., 2009). Therefore, in this study we sought to gain a deeper understanding of differences in how each gender experiences their internship or co-op. We hypothesize that this improved understanding can be used to connect students with internships and post-graduation job opportunities that are more likely to connect with their learning interests. This understanding can also help companies recruit students and include experiences in internships that will meet the interests of a broader contingent of students.

Background Literature

Considering differences in male and female experiences in intern-related experiences is important as females continue to make up only about 20% of engineering students, and an even smaller percentage of practicing engineers. An understanding of what is valued within work experiences could help to tailor recruitment efforts to female students. Research suggests that retention of female students in engineering is generally at least as good as that of male students (Cosentino de Cohen, 2009). Therefore, in this study, we are not looking at internships/co-ops as a means to retain female engineering students, or to motivate them to complete their degrees. We are looking to inform recruitment strategies into engineering and into the engineering workplace. Furthermore, while much has been written about attracting and retaining females in engineering programs, much less has been written about what career path they choose once they have that degree and why (Takahira, 1998).

In general, universities do realize the need to better recruit female students and make attempts to increase their enrollment (Bayles, et al., 2003). However, these efforts are often isolated acts, with each campus or even each department doing different things to promote women in engineering. One of these efforts includes hiring more female faculty or adding mentoring programs, but as Bayles et al. (2003) further note, that is an enormous challenge in itself.

One recruitment strategy is to help males and females better understand what engineers actually do in their work. Notably, however, research suggests that male and female engineers have different views on and experiences within the workplace. It follows that male and female students will also have varying experiences in their intern or co-ops. As Faulkner (2009) found, male engineers have an easier time building work relationships and gaining a sense of belonging within the workplace. Further, while most engineers seek to be inclusive and overt sexism is not common, individuals with a stereotypical masculinity tend to be more influential in project and business decisions. In another study, Ingram, Bruning, and Mikawoz (2009) found that if female students had previous work experience at a company, they were more satisfied with their mentors in cooperative experiences. This finding was truer for female than male engineers, suggesting females work satisfaction is more likely to grow over time.

Researchers further note multiple differences between males and females generally that help explain why they might experience work differently and value different things within it.[1] First, in one study, researchers surveyed males and females in instructional technology (IT) and other professions (Rosenbloom, et al., 2008). They found that men and women differed in what they valued in their work. Generally, men and women who enjoyed using machines or tools were more likely to be in IT. Men and women who enjoyed working with other people were more likely to choose other careers. And, as the stereotype suggests, men were indeed more likely to enjoy manipulating machines and be in IT, while women were more likely to value working with other people and be in other fields.

Literature on male/female differences also discusses how their learning styles differ, which can provide further insight into their on-the-job learning. Keri (2002) notes that males are more likely to be independent learners with a preference for applied learning, while females are more relational or conceptual learners with a preference for more reading and demonstrated instructor knowledge. Thus, males might find more value in the hands-on nature of internships, and females might not rate internships as favorably in relation to in-class learning. Keri (2002) does note that both males and females prefer to collaborate with other people on learning activities; that is, they like to work in groups and on teams. In another study, researchers found that while girls do better in school than boys, they are more critical of their performance (Pomerantz, et al., 2002). Boys, on the other hand, have unrealistically high estimates of their performance. Therefore, we may expect females to be more critical of their internship performance.

Understanding how learning experiences in internships and cooperative experiences differ between male and female students can provide insights into ways to tailor educational experiences to better meet the differing needs and wants of students. Understanding possible differences in what female students value in their work could help to better guide female students to degree programs, extracurricular activities, and jobs that will best use their skills and inclinations—and will ideally lead to greater retention and job placement of female students.

Methods

Students participating in this study were part of the University of Wisconsin – Madison's Cooperative Education Program within the College of Engineering. This program is voluntary and non-lockstep; that is, the coop experience does not have specific prerequisites and is not tied to any particular term. Because experiences are not tied to specific academic terms, the timing of work terms is chosen by the participating students and employers; students participate any time after their first year of coursework, when they are accepted into a specific engineering department, through their second to last semester. This results in a wide variance of technical knowledge by participants. The vast majority of participating students are traditional college students, without previous professional experience. Cooperative education students work full-time (40+ hours per week) for a minimum of 10 weeks during a summer term, and fifteen weeks during a fall or spring term. They are supervised directly by practicing engineers, and are

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[1] Notably, these are generalizations and thus do not apply to individuals. Also, these studies are not making claims as to whether differences are cultural or biological; they are just noting differences in samples with an effort to make broader inferences.

involved in, and responsible for engineering work. They work independently and in team situations, directly mirroring eventual full-time professional engineering positions. Only paid experiences are allowed, and students are typically compensated at 70-80% of the earnings of an entry-level professional engineer. Co-op or internship experiences vary from one to four terms, including summer terms, and are taken for academic credit. Typical length is 2 terms.

Two surveys were used in this study. First, we used the publicly available results from a quantitative evaluation conducted by the Cooperative Education Program directors (see appendix 1 for questions). For that survey, we analyzed information from 304 cooperative education students for terms taking place during the Summer 2009, Fall 2009, Spring 2010, and Summer 2010 terms. Only first term evaluations were used in this analysis. Subsequent terms with the same employer, and additional work experiences by the same students at another employer were not used, to eliminate duplication within the data set. These experiences included students from biomedical, chemical, civil & environmental, computer, electrical, engineering mechanics, engineering physics, geological, industrial, materials science, mechanical, and nuclear engineering programs. They were located throughout the United States, but were heavily concentrated in Wisconsin, Illinois and Minnesota. Twenty-two percent of the students were female (67 out of 304), a slightly higher rate than expected from the overall 19% female undergraduate enrollment in the College.

Collaborating with the program directors, our research team created an additional survey for the cooperative education students. Students took this survey after the same terms, although they answered a different set of questions each term in order to not overwhelm them with too many open-response questions (see appendix 2 for the list of questions). For this survey overall 215 males and 59 females responded, achieving a response rate of approximately 90%; the n for each individual question will be listed. In both surveys the respondents' ethnicities were approximately 90% white, 6% Asian, and 1% or less of other groups.

In order to analyze the quantitative data, we conducted Pearson chi-squared tests to compare the percent of males versus percent of females with particular answers. We also considered general descriptive statistics for this data, noting percentage differences in responses. We solicited open-ended responses to gain a more authentic understanding of these students' viewpoints, and then used a thematic analysis approach to find themes within these answers (Boyatzis, 1998). At least two researchers reviewed the data in generating each theme to add to the validity of the findings.

Findings and Discussion

Data analysis shows numerous similarities and differences between male and female responses. In this analysis, we will focus on a subset of the total questions asked. We will look at questions with marked differences in answers and more briefly review a portion of the questions where answers were virtually the same.

In terms of similarities on the first quantitative evaluation, males and females equally reported that the cooperative experience exceeded, met, or fell below their expectations (question A2). With males being more inclined to enjoy hands-on work (Keri, 2002) and more able to

develop at-work relationships (Faulkner, 2009), we expected that the experience would have been more likely to meet their expectations. We speculate that females could have placed higher value on other areas of their experiences, leading them to have equally high overall satisfaction.

Other similarities matched expectations on this evaluation as literature did not suggest there would differences in these arenas. Each group equally reported the extent of the workload as being excessive, manageable, or light. They also reported being given equal amounts of responsibility in their assignments. Finally, each group stated that they spent similar amounts of time on engineering vs. non-technical activities such as meetings.

Because females tend to be more critical of their performance, we expected them to report greater levels of challenge in their work tasks than males. While females were more likely to note that the experience was "very challenging," 27% vs. 22%, the overall level of challenge reported (very, somewhat, not) was not significantly different by gender: χ^2 (2, N = 304) = 1.1, p = 0.58. See figure 1.
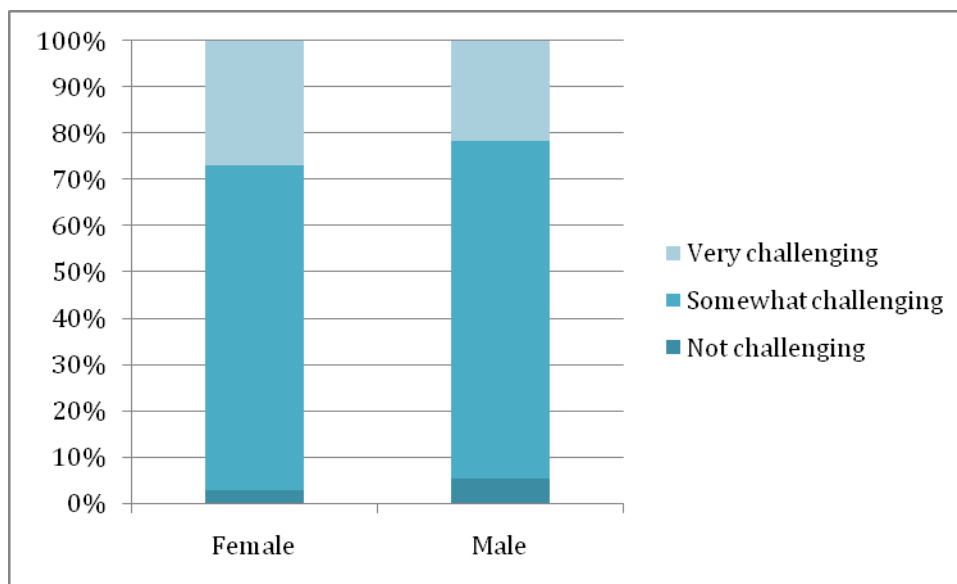

Figure 1: More females than males reported that the cooperative education experience was very challenging but the overall level of challenge was not significantly different by gender.

Based on literature findings, we had no expectation that females and males would report differences in the amount of "significant engineering training" provided within their jobs. Nonetheless, even though genders reported similar levels of responsibilities, only 40% of female students described their experience as providing significant engineering training, while 49% of males described it as significant. However, with a full analysis of these differences, the overall difference in how males vs. females rank the amount of engineering training is not significant: χ^2 (2, N = 304) = 2.31, p = 0.31. See figure 2.
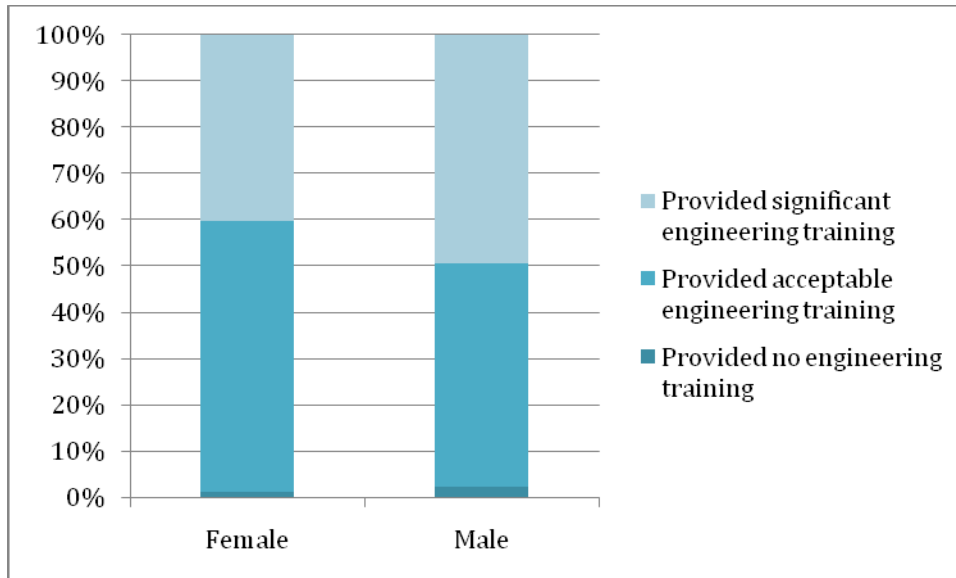
Figure 2: More females than males thought their experience provided significant engineering training but the overall difference is not significant.

Based on literature, we did have expectations for how males vs. females would view their relationships with their supervisors. Because females tend to value communication in their jobs more so than males (Keri, 2002), and because supervisors are more likely to be males than females, we expected females to have a more negative report of their supervisor and his/her support. If we had looked at females beyond the first semester of their experience, we may found different results, as suggested above (Ingram, et al., 2009). In our analysis, the data did show a difference between males and females in relationships with supervisors, though not at a statistically significant level. Sixty-seven percent of males said their supervisors were always available for questions, as compared to 57% of females. See figure 3. Because literature suggests females are less confident in their work (Pomerantz, et al., 2002), it could be that females simply want to ask more questions. A general comparison of results for supervisor availability for questions still does not show statistical significance, however. The chi-squared value with one degree of freedom and 300 respondents is 1.91, producing a p value over 16% $[\chi^2 (1, N = 300) = 1.91, p = 0.167]$ (Note: we left the "rarely" category out of the chi-squared analysis as it violated need of n > 5).
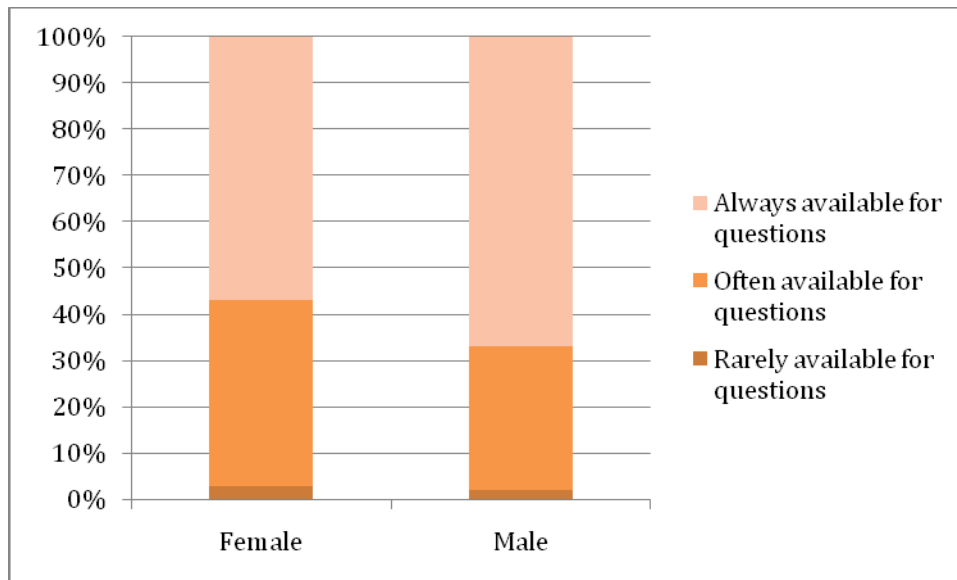
Figure 3: More males than females reported that their supervisors were available for questions but the difference is not significant.

The second survey included open-ended questions to allow for a more nuanced analysis of how males and females viewed their experiences. As mentioned before, analyzing these survey questions included finding themes in responses overall, coding responses by those themes, and then totaling the number of times themes were brought up in all of the responses. To avoid bias, researchers did not know whether respondents were male or female. Researchers then calculated the percent of female and male respondents that mentioned each theme and compared the difference using a chi-squared test.

The first question we will discuss is, "What key things did you learn in this internship or co-op and why are they important?" Table 1 shows the five top themes found in student responses to the question, the percentages of males and females including this theme in their response, and the p-value of the statistical test of difference.

Table 1: Male and female students identify the key things they learned in their internship and co-op programs. (χ^2 df = 1, N = 224)

Learning Theme	Total (N=224)	Male (n=172)	Female (n=52)	p-value
Communication skills	61%	55%	81%	< .0001
Technical skills	29%	34%	12%	.0019
How company, business functions	19%	19%	17%	.76
Time management and organization	17%	13%	29%	.0034
Problem solving	9%	8%	13%	.247

Two learning outcomes related to two of the top five were statistically significant. First, more females (81%) than males (55%) discussed communication. Second, more females (29%) than males (13%) discussed time management and organization. Based on the literature, we largely predicted these learning outcome results, although their significance is beyond what we considered likely. Based on the work of Rosenbloom, et al., (2008), we hypothesized that females would discuss communication more in their learning outcomes. The 81% to 55% difference turned out to be highly significant (<.0001).

Additionally, with the general male preference for machines/tools and applied work (Rosenbloom, et al., 2008; Keri, 2002), we correctly hypothesized that males would be more likely to discuss technical learning within their answers (34% as compared to 12% of females). Admittedly, this difference could also be due to females being involved in internships that could be considered less technical in a traditional sense. We did not think that there would be a significant difference in discussion of time management and organization between the two genders, but the difference did turn out to be significant (29% for females vs. 13% for males). Perhaps this should have been our hypothesis as Keri (2002) notes that females generally value a well organized and planned out learning experience more than males, which could translate into them noting their own on the job organization. The literature does not suggest that there might be a difference between the genders in learning about how the engineering world works or learning about problem solving. The lack of a significant difference in those arenas, therefore, is unsurprising.

We next considered the question, "Tell me about one setback or challenge during your assignment and explain in detail how you handled it." We hypothesized that females would be more likely to discuss challenges dealing with communication (non-technical issues) and males would discuss challenges of a technical nature. While this difference did come up in the data, Table 2 shows that it was not at a statistically significant level. Other themes in the responses such as meeting with co-workers to solve the problem did not show meaningful differences. Notably, both males and females were more likely to have non-technical rather than technical challenges in their work.

Table 2: Male and female students discuss non-technical and. technical challenges in the workplace but the differences are not significant. (χ^2 df = 1, N = 61)

Challenge Type	Total (N=61)	Male (n=45)	Female (n=16)	p-value (comparison)
Non-technical vs. Technical skills	41%	58%	62.5%	0.75
	39%	42%	37.5%	

We then looked more deeply at the question of whether or not the reality of the internship matched with expectations. As mentioned before, contrary to expectations, we found no quantitative difference between males and females in this regard. We thought that a more in-depth look at why expectations were or were not met might yield some differences. Table 3 provides a summary of the themes found within the responses, the percent of males and females noting those themes, and the significance of the difference.

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Table 3: Students identifythemes about whether or not the experience met their expectations. The only significant theme is that females bring up co-worker support more often than males. (χ^2 df = 1, N = 62)

Learning Theme	Total (N=62)	Male (n=46)	Female (n=16)	p-value
Positive	72.5%	74%	69%	0.69
Learned a lot	34%	37%	25%	0.35
Challenging or meaningful work	55%	59%	44%	0.31
Co-worker support	24%	17%	44%	0.026

While only one difference was statistically significant, there were some marked differences between males and females in their descriptions of work meeting expectations. As mentioned before, we had a general hypothesis that females would be less positive than males in this regard due to learning style preferences and gendered workplace norms (Keri, 2002; Faulkner, 2009). Indeed, males were more likely to be positive about their experiences (74% vs. 69%), but not to a statistically significant extent. Additionally, it is notable that males more frequently bring up the idea that they learned a lot and felt they had more challenging or meaningful work. Although not statistically significant, these results agree with our literature-based hypothesis that males prefer this type of learning environment more than females (Keri, 2002). It is possible that if asked directly, females would also say they learned a lot and had meaningful, challenging work; however, it is notable that they do not bring up those facets as frequently on their own when reflecting on their experience. The results do show that females bring up co-worker support more often—to a significant extent (p < .05). This finding further supports our hypothesis that females would value work with others more than males (Rosenbloom, et al., 2008).

In the final question analyzed, we looked at how students described their cooperative experience as compared to other learning experiences as undergraduates. Table 4 shows the four main themes in their responses and the lack of statistically significant differences. But some subtle differences were in line with our expectations. Based on the research that males prefer applied learning (Keri, 2002), it is not surprising that they talk about applying their knowledge more often than females (62% vs. 58%), and it is not surprising that they more frequently say this type of learning was better than other experiences (32% vs. 24%). Females, on the other hand, were more likely to say that their learning in the cooperative experience was "different" than other learning, not calling it better or worse, but saying that each aspect was important. Females were slightly more likely than males to say that they learned about the engineering work environment (29% vs. 24%), but the literature did not suggest specific reasons why that might be the case. It could be simply that on average they have had fewer past connections to the engineering or technical work world.

Table 4: Students identify themes about how this cooperative learning experience compared to others in their undergraduate experiences. None of the differences were significant. (χ^2 df = 1, N = 274)

Learning Theme	Total (N=274)	Male (n=215)	Female (n=59)	p-value
Apply knowledge	61%	62%	58%	0.55
Different	27%	25%	34%	0.18
Better	30%	32%	24%	0.22
Work environment	25%	24%	29%	0.47

Conclusion and Implications

Clearly, results presented in this paper provide a general picture and do not necessarily apply to particular individuals. Looking at a broad picture, these findings support literature indicating that female students place more value on communication and interpersonal workplace factors than male students, while males more often value applying knowledge and gaining specific technical skills. Females and males both definitely value these cooperative learning experiences, but often do so for different reasons. A notable limitation in this analysis is that female students generally have different majors than male students; females are more likely to be in industrial engineering and biological engineering majors.

Directors and Administrators: Directors of university cooperative learning programs could use these findings to recruit students to cooperative programs, help students decide what type of experience they want, and help students reflect on their experiences. In recruiting students, administrators should ensure they emphasize the wide range of learning within these programs to broaden their appeal. They should also work to help students find a work environment that fits their desires and values. Additionally, they should encourage students to reflect broadly on the technical and non-technical learning occurring in their work. Finally, they should have an assessment or evaluation plan integrated into their programs for continuous improvement.

Business leaders: Businesses could apply these findings in their recruitment and support of interns. First, mentors should work to give students a broad range of experience to meet different learning styles, emphasizing both technical and interpersonal work. Tasks given to interns could be fitted to what different individuals might want to learn from, or include enough variety to meet those varying desires. Furthermore, businesses should work to explicitly highlight interpersonal work as an essential component of the job, not treating it as a secondary or background facet of the experience. Of course, businesses should be wary of emphasizing technical skills for males more than females. It could be that females do not report learning as many of those skills because they are less likely to be given those opportunities (or it could be that they are more likely to choose less hands-on, technical internships). With the finding that

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females are somewhat less likely to describe their work as challenging and meaningful, business leaders need to ensure that they have work that meets this criterion, recognizing that the perspective that they hold in this regard might be different than students' perspective. As businesses recruit employees, they might also promote particular aspects of jobs that potential employees would have that they had not emphasized as much in the past, such as teamwork dynamics.

Students: Based on these findings, all students should be aware of the value that internships and cooperative engineering programs add to their learning. Also, they should carefully consider what they want out of an internship or co-op. Do they want to learn new technical skills or be a part of a dynamic work team that collaborates on meaningful problems? Are they likely to spend much of their time working alone or with others?

Moving forward, with broad-based efforts to attract more students to engineering fields, especially female students, it will be particularly important to attend to differing values within the workplace. Because females graduating with engineering degrees are less likely to take engineering jobs after graduation, businesses and university administrators need to do more to determine why that is and what can be done about it (Parker & Ralph, 2003; Takahira, et al., 1998). Recruiting proportional numbers of females to STEM careers would go a long way towards meeting the workforce needs of the future. Engineering internships and cooperative educational programs have a key role in motivating all students, but especially female students.
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Acknowledgements

References

Anderson, K. J. B., Courter, S. S., Nathans-Kelly, T., Nicometo, C., & McGlamery, T. (2009). Understanding the current work and values of professional engineers: Implications for engineering education. Proceedings of the 116th Annual American Society of Engineering Education (ASEE) Conference (Paper no. AC-2009-230), Austin, TX: ASEE Publications.

Bayles, T., Spence, A., & Morrell, C. (2003). Science, technology, engineering, and mathematics talent expansion program: A focus on diversity. Proceedings of the 110th Annual American Society of Engineering Education (ASEE) Conference (Session 2213), Nashville, TN: ASEE Publications.

Boyatzis, R. E. (1998). *Transforming Qualitative Information: Thematic Analysis and Code Development*. Thousand Oaks, CA: Sage Publications.

Cosentino de Cohen, C. (2009). Retention is not the problem. *Prism,* October. Accessed online at http://www.prism-magazine.org/oct09/tt_02.cfm.

Faulkner, W. (2009). Doing gender in engineering workplace cultures. I. Observations from the field. *Engineering Studies*, 1(1): 3-18.

Keri, G. (2002). Male and female college students' learning styles differ: an opportunity for instructional diversification. *College Student Journal*, 36(3): 433-442.

Laxman, D., Bright, M., & Renshaw, S. (2005). Internships: Lessons learned beyond the classroom. Proceedings of the 112th Annual American Society of Engineering Education (ASEE) Conference, Portland, OR: ASEE Publications.

Lubinski, D., Benbow, C. P., Webb, R. M., & Bleske-Rechek, A. (2006). Tracking exceptional human capital over two decades. *Psychological* Science, 17(3): 194-199.

Marshall, J. (2010). Professional internships: A requirement for graduation. Proceedings of the 117th Annual American Society of Engineering Education (ASEE) Conference (Paper no. AC-2010-289), Louisville, KY: ASEE Publications.

Milliken, B. & Fatehi, F. (2007). Co-op and internship opportunities for the department of electronics, computer & information technology. Proceedings of the 114th Annual American Society of Engineering Education (ASEE) Conference (Paper no. AC-2007-1660), Honolulu, HI: ASEE Publications.

Parker, P. J. & Ralph, E. E. (2003). Retention of Recent Women Engineering, Mathematics, and Science Graduates in the Workplace. Proceedings of the 110th Annual American Society of Engineering Education (ASEE) Conference (Session 1392), Nashville, TN: ASEE Publications.

Pomerantz, E., Altermatt, E., & Saxon, J. (2002). Making the grade but feeling distressed: gender differences in academic performance and internal distress. *Journal of Educational Psychology*, 94(2): 396-404.

Rosenbloom, J. L., Ash, R. A., Dupont, B., & Coder, L. (2008). Why are there so Few Women in Information Technology? Assessing the Role of Personality in Career Choices. *Journal of Economic Psychology*, 29(4): 543-54.

Takahira, S., Goodings, D. J., & Byrnes, J. P. (1998). Retention and performance of male and female engineering students: An examination of academic and environmental variables. *Journal of Engineering Education*, 87(3): 297-304.

Tener, R. K., Winstead, M. T., & Smaglik, E. J. (2001). Experiential learning from internships in construction engineering. Proceedings of the 108th Annual American Society of Engineering Education (ASEE) Conference (Session 1315), Albuquerque, NM: ASEE Publications.

Wirsbinski, S., Anderson, K. J. B., & Courter, S. S. (2009). Understanding the current engineering profession by analyzing the male and female engineers' interpretations of the workplace. Proceedings of the Annual North Midwest American Society for Engineering Education Conference.

Appendix 1: Questions from the end-of-term evaluation filled out by students in the cooperative education program

- A: The following statements best describe my assignment:
  - A1
    - Very challenging
    - Somewhat challenging
    - Not challenging
  - A2
    - Exceeded expectations
    - Met expectations
    - Fell below expectations
  - A3
    - Provided significant engineering training
    - Provided acceptable engineering training
    - Provided no engineering training
  - A4
    - Worked well beyond current courses
    - Complemented current courses
    - Had no application to current courses
  - A5
    - Workload was excessive
    - Workload was manageable
    - Workload was light

- B: The following statements best describe my supervisor:
  - B1
    - Provided direction and explained goals
    - Provided enough direction
    - Provided little direction
  - B2
    - Gave me feedback often
    - Gave me occasional feedback
    - Gave me no feedback
  - B3
    - Granted high level of responsibility
    - Granted medium level of responsibility
    - Granted low level of responsibility
  - B4
    - Always available for questions
    - Often available for questions
    - Rarely available for questions
  - B5
    - Viewed me as a professional
    - Viewed me as an errand runner
  - B6

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- - A good managerial role model
  - An average managerial role model
  - A poor managerial role model

- C. Time spent on the following activities:
  - C1
    - % of time performing engineering tasks
    - % of time in non-technical activities (meetings, preparing correspondence, etc.)
  - C2
    - % of time working as an individual
    - % of time working as a team member
    - % of time working with individual staff

- D. Overall, my experience:
  - D1
    - Exceeded expectations
    - Met expectations
    - Fell Below Expectations

- Compensation:
  - Hourly or Monthly Compensation
  - Total Compensation for Term

Appendix 2: Survey questions given to students in addition to the normal evaluation, with open-ended questions being split between spring, summer and fall semesters (online format is different than below)

1. Bachelor's degree – expected year of completion:

2. Bachelor's degree – expected engineering field:

3. In which semester did you just participate in a internship or co-op?
> Fall Semester
> Spring Semester
> Summer Semester

4. Briefly describe the organization (less than 100 words):

5. What were the major responsibilities of your work assignment? If completing a second (or greater) term, please explain how this term differs.

6. How did the reality of your work term compare to your expectations prior to starting the position?

7. Of which three accomplishments during your term are you most proud? Why?

8. Identify three courses at UW-Madison from which you have applied knowledge to your work term. Cite specific examples of the application of this knowledge.

9. Tell me about one setback or challenge during your assignment and explain in detail how you handled it.

10. What have you learned about working with people in a professional environment?

11. Explain why this assignment has or has not helped prepare you for working in a diverse world.

12. Having been through the job search process for this assignment, what things will you do differently in future employment searches?

13. OPTIONAL: Describe any special recognition you received from your employer.

14. Briefly describe the organization (less than 100 words):

15. Summarize your responsibilities and contributions to the organization.

16. Provide an example of how effective teamwork and communication skills helped you accomplish an important result on the work site.

17. Describe a work situation which demonstrates your leadership abilities.

18. Discuss how this experience has challenged and altered your perception of what an engineer does.

19. Based on your work assignment, what do you think it takes for a person to be successful in engineering and explain your preparedness in these areas?

20. What is the most significant thing you learned during your assignment that you didn't learn in college?

21. Supervision can be one of the most challenging assignments. Identify the supervisory styles in your organization and comment on their effectiveness and your future approach to supervision.

22. OPTIONAL: Describe any special recognition you received from your employer.

23. Briefly describe the organization (less than 100 words):

24. Summarize your responsibilities and contributions to the organization:

25. Using specific examples, cite three experiences on the work site that demonstrated limitations in your professional skills. Explain how you have worked on improving them or how you will in the future:

26. Provide a specific example of where you went beyond what was expected by a colleague or supervisor to complete a task:

27. Taking a "big picture" perspective, what have you learned about the field in which you work? For example, will jobs be increasing/declining and what are the economic challenges of the industry:

28. Describe the worst communication problem you experienced in your position. What were the root causes, how could it have been avoided, what have you learned about communication:

29. Would you take this position again? Why or why not:

30. What have been the two best decisions you made during your term? Elaborate on how you reached these decisions and why they were positive:

31. Describe an instance where you made effective use of facts to secure the agreement of others:

32. OPTIONAL: Describe any special recognition you received from your employer.

33. What key things did you learn in this co-op or internship and why are they important?

34. How does your learning within the co-op or internship compare to your other learning experiences as a student? (i.e how was it better or not as good as classes, labs, clubs, etc.)

35. How do engineers approach and solve problems?

36. Consider how well your co-op or internship has improved your understanding in the following areas: (Not at all - A little - Somewhat - A lot)
      a) Values of engineers
      b) Skills of engineers
      c) What you need to do to become an engineer
      d) Way that engineers think

37. What is your gender?
      Male
      Female

38. What is your race/ethnicity?
      American Indian or Alaskan Native
      Asian
      Black or African American
      Hispanic or Latino
      White
      Other, please specify