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“Addressing Learning Requirements Particular to Women in Engineering”

A study to be applied to Design Project Management in the Fall Q 2010

Target Students – Fourth and fifth year engineering students

Problem to Address – Engineering class have been predominantly male. Female students must adapt to curricula that have been refined to optimize learning for male students. Teachers and engineering students are not aware of subtleties in behavior that inhibit female success.

Proposed Solution – Identify a few significant obstacles particular to female students in engineering and explore some mitigating strategies,

Assessment method – Qualitatively survey female students to determine if the mitigating strategies are valuable and how they might be improved.

My objective is to identify methods to improve the learning experience of women engineers by gaining a fuller understanding of how their learning requirements differ from male students.

Beginning with a study of the effects of gender on learning mathematics by Matheus, I was surprised to learn that girls hear ten times as well as boys. As a consequence, girls often feel that their male teachers are always shouting. This tends to have a negative effect on adopting male teachers as role models which then fails to encourage them to pursue male dominated fields in general. Girls also are better integrators of the information they acquire partially due to a superior ability to multitask. Boys need an interruption, generally one that includes physical activity, before changing subjects to allow them make the appropriate conceptual connections required for true learning. Studies also reveal real differences in the brain structures of boys and girls. Girls have a larger corpus collosum and “stronger neural connectors in their temporal lobes” leading to better memory and listening skills. They consequently tend to employ their brains more holistically while boy’s brains tend to be more compartmentalized. This suits the boys better to tasks that are more focused since they are naturally less distracted.

A study by Ingram indicates that many women abandon engineering because they perceive the required commitment to a heavy workload to be in conflict with a balanced lifestyle. This is exacerbated by a lack of role models with whom they can explore this concept. I worked closely with Ursula Burns when she assumed her first managerial role at Xerox and I was very aware that her male counterparts used gender specific activities to combine some level of relaxation with continued work discussions amongst their teams. These often took the form of corporate boxes at sporting events where the men could enjoy the game as well as discuss business strategies, plans and significant influencers. Ursula’s entourage went shopping which made it difficult for her to informally collaborate with the men on her team. Of course she was able to overcome this problem as she found mentorship with CEO Anne Mulcahy. Ingrahm’s study goes on to explain that the satisfaction women experience with a career in engineering is very

dependent on their co-op experiences. Clearly this is an area that KGCOE needs to study more carefully since we are so closely associated with this practice. I am not aware of any special attention given to the co-op experiences of female engineers.

I have also interviewed a few women engineering students in KGCOE to get their perspectives. They claim that students in engineering differ from their non engineering experiences in that engineers are more focused on results and the reliable building blocks that allow them to get to those results. There is a lot more work and commitment required to pursue an engineering degree than say one in liberal arts, resulting in less time for other activities. Women engineers who don't want to make that commitment get sorted out by the second semester. This was supported by the work of Morris who studied the "chilly climate" of non traditional majors for women. In truth her findings indicate that women in engineering describe the climate as more chilly than men do resulting in the need for greater independent motivation. However, she also indicated that women found traditionally female field like nursing to be even chillier for women. She concluded that women, particularly in engineering, understand the climate and either adapt or change their major. In a separate study, Murphy found a reduced willingness to participate from women who are placed in a gender unbalanced situation while the opposite is in fact true for men. A study by Ihsen further supports the climate impact of "unspoken rules" specific to engineering where there tends to be an inbred requirement to prove oneself using traditional methods. This may actually be a characteristic of all disciplines of higher learning but those dominated by males will continue to be somewhat foreign to females.

Engineering and other technical fields tend to pose problems whose solutions can be quantified. Consequently, their relative goodness can be more objectively determined. Engineers in general are more blunt and objective. Male engineers interpret conditional modifiers such as, "I'm not an expert but.." as weakness and therefore discount any conclusions that follow. Women tend to use these modifiers more often and male engineers tend to attack arguments that include such phrases. According to Wolfe, these individual instances are nearly negligible but they are so frequent that they accumulate to have a significant impact. Women engineers need to be made aware of this phenomenon so that it does not take them by surprise. This becomes a more sensitive subject when team activities are employed "In fact, as far as women are concerned, there is some reason to suspect that team projects might actually accelerate attrition..." Men also need to be made aware that their speech patterns and reaction can have a negative impact on the effectiveness of their teams.

Women engineers often accumulate more information than male engineers do before they draw a conclusion. Men tend to pose solutions with as little as half the information. This early leap to a conclusion may be driven by the basic need to compete that men exhibit. Also they tend to use the debate to test theories so when their theory is defeated they can accept it as an expected progression of their understanding. Possibly because they are careful in formulating their position, women are more personally invested in their conclusions than men are and may therefore be more persistent in defending their position. This may contribute to a generally accepted, though anecdotal, observation that men can ferociously debate a decision with other men without putting their personal relationship in peril. However, when two women debate a point with equal ferocity their personal relationship often

suffers long term negative effects. As I have discussed this point with several colleagues I find that they either strongly agree or strongly disagree but few are neutral.

Much of this collection was summarized in a work by Amelink. Her conclusions are that;

- Faculty attention to student learning and satisfaction drives a female engineer's satisfaction with engineering as a major and her commitment to this as a career
- Unfacilitated work groups can have a negative impact on female satisfaction even when they are comfortable with a minority status
- Acceptance of peers is critical mostly because they spend so much of their time amongst engineers
- Positive role models are rare but critical success factors for female engineers who are more concerned with life balance than their male counterparts
- Respect from peers and faculty is important but females are less sensitive to the opinions of other females

In my experience relatively few science, technology, engineering and math students study these subjects because of their love of the subject matter. They are extrinsically motivated to learn new tools that can be applied elsewhere. It is not like literature, where the reading is sufficiently satisfying by itself. Male students are generally more extrinsically motivated so they are more comfortable and motivated by the traditional engineering learning environment. It may be valuable to women engineers if their teachers focus more on the beauty of engineering principles and their harmony with the physical world they attempt to describe.

Women are also generally able to apply a higher level of diligence to tedious task than men are. This is evidenced by the preponderance of women in fields such as biological cell discrimination. In general the quality of their work does not degrade nearly as quickly. Women may in fact be better at deeply analytical tasks and therefore may be better suited to modeling and design reviews while men may be better suited to the synthesis tasks that require a leap of imagination to create a new concept or model. Clearly this requires some corroborating data but being a male engineer, I am proposing a model without a lot of supporting data and must now look backward to conduct a defensible analysis.

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