AC 2008-1070: GENDER DIFFERENCES IN THE VALUES OF MINORITY HIGH SCHOOL STUDENTS THAT AFFECT ENGINEERING DISCIPLINE CHOICE & RECOMMENDATIONS FOR ATTRACTING MINORITIES TO ENVIRONMENTAL ENGINEERING

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Gender Differences in the Values of Minority High School Students that Affect Engineering Discipline Choice & Recommendations for Attracting Minorities to Environmental Engineering

Abstract

In the summer of 2007, Michigan Technological University held a week long Engineering Explorations summer camp for minority high school students considering engineering as a major in college. Nine gender separated groups each attended the hour and a half session about environmental engineering and wastewater treatment. The males were in four groups of 7-10 students each, including a total of 35 male students. The females were in five groups of 6-8 students each, resulting in a total of 36 females.

It is well known that, among the engineering disciplines, environmental engineering has been comparatively successful at attracting female students. It is suspected that male and female students may have different values which drive career choice as students. This paper details gender differences in the questions raised by students during the introduction to wastewater treatment session. The subjects and questions raised by the students in each session were recorded, the results of which reveal distinct value differences among males and females when choosing a future career.

Suggestions are made for ways to attract minorities to the discipline by focusing on their values in recruitment efforts.

Background

Although environmental engineering has been known for its success at attracting female students, it has not experienced the same success at attracting minority students. It has been shown that only a few key institutions within the country have actually managed to attract minority students into environmental engineering at percentages higher than the national average of enrollment for minorities in engineering overall¹. Thus, as a whole, environmental engineer has room for improvement with regards to diversity of student body.

A growing body of research is recognizing the role that culture plays in the appeal of careers to individuals. For example, gender roles and expectations, which vary between cultures, can influence what women will view as appropriate careers. Studies have shown that women are represented in much higher numbers in engineering and computing sciences in Puerto Rico and China than within the

mainland US²⁻³. Thus, as cultural expectations of for females can affect career choice, it follows that the same would be true for males as well.

Studies abound indicating the unique values women express when choosing engineering careers. It has been well documented that women tend to choose the fields of engineering that have an altruistic value to them, and think about the societal impacts of their future careers^{4,5}.

A recent study at the University of Minnesota asked students about the roles that family, mentors, societal benefit, and financial rewards played in motivation to study engineering⁶. The study found that social good was the highest motivation to study engineering, followed by financial motivation, mentor influence, and family influence. The study claimed no differences in motivation between genders, but encompassed 85% males and 80% Caucasians. Thus, the study primarily represented the motivators of Caucasian males. Still, the study emphasizes that males, as well as females, may be motivated to study engineering because of the social good, even more than the financial rewards of engineering.

Another significant motivator for girls to study engineering is that of parents^{2,4,6}. Recent research has shown that parental support for career choice matters to girls⁷. Parental support, especially that of the mother, is a documented factor in the significant number of Puerto Rican women studying engineering², and may hold true for other minority students as well.

The literature indicates that perceived roles, desire to contribute to society, family support, and pay may be among the motivating factors for those entering engineering. This study attempted to gain insights regarding the motivations of minority students to study environmental engineering, as reflected by the questions asked by the students.

Methods

In the summer of 2007, Michigan Technological University held a week long Engineering Explorations summer camp for minority high school students considering engineering as a major in college. Nine gender separated groups each attended the hour and a half session about environmental engineering and wastewater treatment. The males were in four groups of 7-10 students each, including a total of 35 male students. The male students were composed of 30 African Americans and 5 Hispanic students. The females were in five groups of 6-8 students each, resulting in a total of 36 females. The female students were composed of 35 African American and 1 Hispanic Student.

Throughout the course of each session, the subject of each question raised by a student was recorded as it was asked. General themes emerged among the questions asked by the students and differences existed in the question themes between genders, indicating separate motivations for engineering career choice between minority male and female students.

Questions Raised by Students

A summary of the general subject themes of the questions/comments raised by the students, and division of the questions between genders, is presented in Table 1, and discussed in this section.

During the sessions, a general theme emerged among the questions/comments raised by the female students. The majority of the questions raised by the females pertained to what it is that environmental engineers do, and why it would be appealing.

All of the students were presented with a general overview of the field of environmental engineering, including typical jobs that an environmental engineer might choose upon graduation. Of the 36 females, 15 asked for additional clarification about the job tasks of an environmental engineer. The students were questioning what it is that environmental engineers do on a daily basis.

13 of the 36 females were also curious about whether the instructors liked their chosen fields. The students asked questions regarding why the instructors liked environmental engineering. Similarly, 7 females asked questions regarding why the instructors chose environmental engineering as a field, and what it was that attracted them to the discipline.

As the session included a field trip to the local wastewater treatment plant, two groups expressed aesthetic concerns related to the field trip. 15 of the 36 females expressed concern that the field trip would be “gross” or smell bad, resulting in detailed discussions of the typical sites and smells of a wastewater treatment plant.

A final unanticipated response among the female students included the number of females that indicated they had no interest in the engineering field whatsoever. In fact, 8 of the 36 females in the sessions indicated they only attended the engineering camp because their mothers had made them.

Differences exist between the general themes of the questions raised by the male students. While the female students tended to ask what environmental engineers

do, and inquired as to its appeal as a discipline, the male students tended to focus on pay and job security.

The variation among the salaries of engineers was a significant concern of the male students. 19 of the 35 males asked questions regarding the pay differences between the engineering disciplines. Similarly, 9 of the male students inquired as to the influence of educational level upon pay, asking about typical pay ranges for an entry level engineer with a bachelors, masters, and doctorate degree.

Another significant concern among the male students was job security. 19 of the 35 males inquired about the ability to find a job within a specific discipline, or the prospect of that discipline over time. Most of these questions were directed towards the mechanical engineering field, as the automotive industry has historically hired many of the Michigan Tech mechanical engineering graduates.

7 of the 35 males asked questions regarding the differing job tasks among the engineering disciplines. However, these questions tended to be design focused, inquiring as to what type of engineer would design a specific technology. Only 9 of the 35 males questioned what it is that environmental engineers do specifically.

Results and Suggestions for Attracting Minorities to the Discipline

Immediate differences emerged between the questions asked by the male and female students. The purpose of the session was to introduce the students to the field of environmental engineering. While 15 of the 36 females asked questions pertaining to the job tasks of environmental engineers, only 9 of the 35 males asked similar questions.

Only the female students asked questions regarding whether their instructors liked environmental engineering, and why they chose it as a discipline. These questions indicate that the female students may be more concerned with finding a career choice that they will like. Appeal of the field was a significant concern, with 15 of the female students indicating their concern that wastewater treatment may be unappealing.

7 of the 35 male students did ask questions regarding the differences among engineering disciplines. But an even greater amount, 19 of the 35, inquired as to the pay differences among the disciplines. Additional male students inquired as to the influence of educational level upon pay. Along with salary, Job security emerged as a major theme of the male students' concerns, with 19 of the 25 inquiring about job security.

When learning about environmental engineering as a career choice, the female students were more concerned than the male students with what it is that environmental engineers do and whether or why it may or may not be likable, while the male students were more concerned with how much the field paid and the likelihood of employment in comparison to other disciplines.

The current diversity challenge to the field of environmental engineering is in attracting minorities to the discipline. It is recommended that recruitment efforts for minority females provide adequate descriptions of the typical job tasks of an environmental engineer, including testimony from women practicing in the field regarding what they like about their jobs. Recruitment efforts targeting minority males should include information about salary ranges and projected national needs for environmental engineers, in addition to describing the field.

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Table 1: Summary of Question Subjects Raised by Male and Female Students		
General Subject Theme	Number of Questions or Comments which fit into the General Subject Theme	
	Female (36 present)	Males (35 present)
Clarification regarding the job tasks of environmental engineers	15	19
Aesthetic concerns regarding the field trip to a wastewater plant	15	0
Whether the instructors liked environmental engineering	13	0
The students actually had no interest in engineering, but were attending at their mother's insistence	8	0
Why the instructors chose environmental engineering	7	0
Differences in employability of the various disciplines upon graduation and over time.	0	19
Clarification of the salary differences among engineering disciplines	0	19
Influence of educational level upon salary	0	9
Clarification regarding the differing job tasks among engineering disciplines	0	7