A "MALE THING":
WHY COLLEGE WOMEN ARE NOT CHOOSING STEM MAJORS

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ABSTRACT

The purpose of this study is to add to the current research concerning women in science, technology, engineering and mathematics (STEM) programs, and to better understand why university women are not choosing STEM majors, specifically those within the faculty of Information Systems and Technology. Qualitative Data were collected through focus group interviews with 45 undergraduate university students in non-STEM majors. The focus group results suggest that women lack interest in, and have insufficient knowledge regarding information technology. Furthermore, stereotypes can lead women to think that STEM is a "male thing". Young women seem to base their program choices on careers that will allow for them to have a family, and the need to (or expectation that they should) nurture others leads them to enroll in healthcare and education majors.

Keywords: STEM, Gender, Women, Information Technology (IT), College Women

PROBLEM

As the technology field experiences increasing levels of global competitiveness, the demand for skilled STEM workers rises as well. Industries concerned with Science, Technology, Engineering and Mathematics are now more important than ever, and we must also address the lack of female enrollment in STEM based programs. Historically, STEM fields have seen predominantly male involvement, and in this paper we would like to examine the reasons that girls and women give for deciding not to go into STEM degree programs and careers.

It is the experience of the researchers that some girls and women feel that STEM related degree programs are geared more toward males, feeling that they are "guy jobs", while other young women simply don't know enough about the programs offered to make an informed decision. These types of degrees have not been advertised to them or presented in a way that makes the possibility of completing one of these programs close enough to a reality for them.

It is clear that the women are integral to the diversification of the workforce. For the most part, women are socialized to think differently than men, so having their input should provide alternative perspectives to STEM-related projects. Gender diversity in the STEM workforce can bring more creativity and innovation. Additionally, we submit that if women are not included in the process of solving the problems, and participating in the challenges in which scientist and engineers are currently engaged, then the requirements of women may not be considered in the outcomes.

The authors of this paper are instructors and students in the Information Systems and Technology department at a large public university and have observed that there is a discrepancy between the number of men and the number of women. Women in this department make up 18% of the faculty, and less than 12% of the student body. In this paper, the authors hope to determine why it is that so many women choose not to pursue careers in science, technology, engineering and mathematics (STEM) programs. Through focus groups, we hope to provide some insight into how female students make programmatic choices in order to address the way that opportunities are presented by high school and college advisors.

Though the authors make reference to STEM careers throughout this article, and are interested in determining why

so few women enter STEM careers in general, the focus of this study remains with Information Technology programs, as this is where the authors work and study. Additionally, the Dental Hygiene program from which many of the participants were sampled is part of the same College as the School of Information Technology, which explains the convenience of the convenience sample.

LITERATURE REVIEW

With the demand for STEM careers rising so rapidly, it might cause one to wonder why women are so underrepresented in STEM. As a matter of fact, STEM careers are not characteristic of most workforce trends. According to the Census Bureau's 2009 American Community Survey, women represented 48% of the United States workforce but only represented 24% of the STEM workforce (Beede, et al., 2011). A recent study from the Brookings Institute reported that:

"STEM graduates have the best opportunity for employment while highlighting that the American education system is not aligned to this new reality. There is untapped potential in the STEM job preparedness pipeline because 74% of girls in middle school say they are interested in studying STEM subjects while less than 20% of women graduate with STEM field degrees."

Recent studies show that only 2.4 percent of college graduates come from computer and information science programs (Newman, 2012). Of those graduates only a quarter of the total technology and computer science graduates were women (Gilpin, 2014). Obviously these numbers show that there must be some discouraging factors that are keeping women out of the STEM workforce.

Statistics indicate that this trend has been occurring for two decades, dating back to the 1990's. From the years 2000 to 2009, women's roles in STEM careers remained constant at 24% despite the number of female college-educated graduates increasing from 46% to 49% (Beede, et al., 2011). This statistic is remarkable as it demonstrates that the number of women choosing STEM careers did not rise appropriately to represent the higher increase in women's college graduation rates.

At this point it is important to consider the degree programs from which the women in the STEM fields actually graduate. According to the ESA, the majority of women, or 57%, acquire physical and life sciences degrees. The rest are spread out across the disciplines with 18% of women acquiring degrees in engineering, 14% in computer science degrees, and only 10% earning math degrees (Beede, et al., 2011).

It is surprising that more women do not pursue STEM careers. After all, STEM degrees pay more than non-STEM degrees for both men and women on average. In fact, in 2009, women who worked in STEM jobs earned 33% higher wages than women with non-STEM jobs (Beede, et al., 2011). According to a report by CHMURA Economics and Analytics, "STEM occupations paid on average $85,200.00 compared with $45,100 for non-STEM occupations" and BLS data show that, "workers in STEM occupations earned a median annual wage of nearly $76,000.00, more than double the $35,000 median wage for all workers in May of 2013." Figure 1 shows the pay gap in selected STEM in women's earnings as percentage of men's earnings in 2013.

Claudia Goldin, a Harvard University Labor economist, reported in 2014 that "[t]ech jobs have the smallest gender wage gap in all occupations." She continues, "[t]he New York Times noted that female computer programmers and women in computer sciences made about 90 percent of what men in the same occupations made." A report by The American Association of University Woman showed that, "[t]ech occupations have relatively small pay gap between men and women". Elizabeth Ames, a vice president at the Anita Borg Institute said, "It is definitely the case that wage gap is less in tech."

In 2014 the overall wage gap for women in the United States was 21%, which was demonstrably higher than that existing in STEM careers. The good news is that the wage differential has trended upward from a 41% gap in 1974 (Hill, 2015). The gap continues to be unacceptable but with the lower gender wage gap, one might be inclined to think more women would gravitate towards STEM.

While there is a wage gap between men and women in STEM, the amount earned depends on which STEM discipline was examined. For example, the computer and math wage gap is 12%, the physical and life sciences wage gap is 8%, the STEM managerial wage gap is at 9%, and the engineering wage gap is the lowest at 7%, with the overall STEM wage gap average totaling 12% in 2009 (Beede, et al., 2011). Although the percentage that pay differs between men and women is lower than in non-STEM careers, it is still simply unacceptable and needs to change.

Another interesting factor concerning women and STEM is that women who graduate with STEM degrees commonly do not get STEM-related jobs. A study conducted by the ESA in 2009 calculated that women with STEM degrees end up with STEM jobs only 26% of the time. Their workforce is spread into other fields where 14% work in educational occupations, 19% work in healthcare occupations, 11% are non-STEM managers, 6% work in business and financial occupations, and 23% work in other fields entirely (Beede, et al., 2011).

Recent studies have examined the way in which men and women perceive each other's skills in mathematics, and have identified an unconscious bias in both genders. When asked, both the men and the women made statements that suggested that they thought that men are better at math than women. After initial questioning, the researchers then divided the group and gave both men and women the same math exam and found that both groups did equally well on test material (Bohannon, 2014, p. 1033).

Bohannon's findings corroborate studies that implicate the kind of encouragement girls receive in STEM classes for their attitudes about their futures. For example, according to a study done by Corbett, Hill, and Rose, girls that grow up in an environment that cultivates their interests and achievements in math and science while building their skills and confidence are more likely to consider a future in a STEM field (Corbett, Hill, & Rose, 2010). Similarly, Boner finds that when teachers and parents encourage girls' intellect and help them to grow their experiences and learning, then those female students do better on math tests and want to continue their studies in math related fields (Boner, 2013). According to the High School and Beyond Study and the Educational Longitudinal Study, three decades of data were collected and concluded that despite male participants scoring only slightly higher in evaluations, women were able to understand and master math just the same as their male counterparts (Randall, 2013).

Dr. Meg Urry, the chair of the Physics Department at Yale University, feels that problems with low enrollment are due to the environment created by a predominantly male student and faculty population. Urry sites obstacles, such as being outnumbered by males, structural problems at the universities, being perceived as a joke, and not recommended for promotions as contributors to the problem. This discourages women in these fields and decreases their participation in STEM majors (Boner, 2013). The findings of a recent research study showed that another reason for low enrollment in the sciences is related to gender socialization practices that see society and family members hold boys to higher academic standards than girls.

Cultural stereotypes indirectly push women away from science fields. Researchers believe that female students that are highly skilled in two areas, will choose to develop skills in the discipline that is more in line with social stereotypes and has more support than math or science disciplines even though they are just as talented at both (Szalavtz, 2013). Research studies show that people think women and men that work in IT are "tech oriented, intelligent and socially impaired" and according to Washington, girls are identifying IT fields as too "geeky" and are having a difficult time identifying themselves as part of the culture (Townsend, 2014) (Washington, 2015). A study by Varma (2009) showed that males students were thought to have a stronger interest in and relationship with technology than women. Some of the subjects expressed beliefs that men should take on more difficult tasks than women, and that men are rational, while women are emotional (Varma, 2009). During Arcidiacono and Rampell's research study, a subject gave the opinion that women place a higher value on grades than men did, and so they chose fields where a more merciful grading curve is found (Rampell, 2014).

Gender is even shown to play a role in the types of experiences that students may acquire. In fact, Shashaani concluded that fifty-eight percent of males stated they had computer experience while only forty percent of females did. More males reported taking technical classes during high school, and out of both males and females that took technical classes, more males took programming classes (Shashaani, n.d.).

A Study by the National Center for Education Statistics found that some of the most popular Masters degrees earned by males were STEM related, while no STEM programs made the most popular list for women. The Masters

programs that women leaned toward included education, nursing, social work and counseling. The researchers determined that women wanted to be at home with their children and these careers are considered to be flexible enough so they could do that (Marks, 2015).

METHODOLOGY

A qualitative research design was used to collect data for this study. To have the best understanding of why women do not choose IT as a major, focus group interviews were conducted in an effort to capture direct quotes from the subjects' personal experience and ideas. Focus Group interviews allowed researchers to ask open ended questions and gather as much information as possible from the subjects. The group setting allowed for the subjects to elaborate on each other's responses and endorse more ideas, which lead to more data and information collected. Researchers also used purposeful sampling, selecting non-STEM female students to better understand why they chose their selective major. Non-IT female students had the best insight into why women do not choose IT, and that is why they were selected to participate.

All 45 of the study's participants were women, primarily in, but not limited to, the Dental Hygiene program offered at the same Midwestern public university where the researchers teach and study in the School of Information Technology. Demographic data was not collected, beyond the gender of the participants. Researchers conducted seven focus group interviews. Groups one through four had seven subjects, group five had six subjects and group seven had two subjects. The focus group facilitators identified themselves as undergraduate students working on a research study that pertains to major selection. Written informed consent was obtained from subjects. Each focus group was audio recorded to be analyzed and transcribed at later time. The groups were all asked the same seventeen questions:

1. What is your major?
2. Why did you choose this major? How?
3. Do you feel that you have a good understanding of math?
4. Do you feel that you have a good understanding of science?
5. What do you think about computers and technology?
6. Do you feel you have a good understanding of computer skills?
7. Do you know what a person with and IT degree does after college?
8. Do you feel confident that you could learn IT skills?
9. Which majors on campus do you feel are predominantly male? Why?
10. What majors do you feel have a large concentration of women? Why?
11. Does the idea of a major with fewer enrolled women discourage you from pursuing it?
12. Would a major with a few female faculty members discourage you from pursuing it?
13. Do your experience in grade, middle, and high school teacher computer skills?
14. Were you given the impression that male students are good at math and science, but female students generally are not?
15. Do you feel that male students naturally excel at certain majors?
16. Do you feel that female students naturally excel at certain majors?
17. Why do you think there is low enrollment of women in IT majors?

The questions for the focus group were developed by the authors, based on a review of surveys prepared for similar studies, and tailored to the local population. Additionally, because the authors have a vested interest in improving the numbers for women in Information Technology, many questions concentrated on participants' interest in IT programs. Focus group facilitators read the questions and allowed time for each participant to answer. Not every participant had an answer for each question. Some of them simply agreed with others who answered, or did not answer at all. Each participant was assigned a number in an effort to keep their identity anonymous. Group one included participant one through seven, group two included participants eight through fourteen, and continued in that manner.

Using purposeful, homogeneous and convenient sampling worked out well for this study. The goal was to focus on the particular characteristics of how female students go about major selection. Due to time constraints and lack of resources a convenience sample was used, wherein Dental Hygiene students were asked to participate because they were in the same building as the authors. The authors recognize, however, that disadvantages exist when using focus groups. Examples of these might include less control over data produced, difficulty analyzing data, an inability to generalize to a larger population. Additionally, researchers may find that some focus group members that just simply agree with others because they do not have their own opinions. This can skew the results when analyzing subjects' responses.

FINDINGS

Analyzing focus group transcriptions revealed various themes. Themes derived included:

1. women want careers that allow them to help others
2. men and women are equal
3. stereotypes die hard
4. more stereotypes
5. female students lack interest and knowledge

Women Want Careers that Allow Them to Help Others

Focus group participants were women of non-STEM majors and had picked their major for various reasons. The most common explanation was that they wanted help others. Ten out of the forty-five participants specifically said that gave this reason as their motivation, and other participants with different answers generally agreed with that reasoning.

Other responses also support the idea that major choice for women is related to helping others. Some of the participants want to be in healthcare, which of course involves the care of others. Since thirty-four of the forty-five participants are dental hygiene majors, there were some responses that they wanted "to improve others' smiles" or dental health, which also supports the general "caring for others" theme as the most common reason on why they chose their major. Some felt that dental hygiene is easier than nursing and would have better working hours as well.

Another response concerning degree choice is related to participants' personal interest in their chosen major. A study shows that this is common and even states that students often feel that they influenced their decision of major themselves (George-Jackson, 2012). Despite the conclusions from that study, our focus groups have only five participants that said that was their reasoning for choosing their major.

Finally, our focus groups revealed some less common reasons regarding the women's choice of major. Two participants said that their reasoning was family-influenced. Participant twenty-four responded with, "I chose this major because my sister did this program and she kept telling me to do it. Originally I was interested in radiology but she kept talking about the program and got me interested in it". This supports a study that found that parental influence can have a positive or negative affect regarding students' career choices (Workman, 2015). Two participants said that their degree choice was based on the resulting career's hours and flexibility. And finally, one participant says she chose Agriculture Business due to the fact that she had grown up on a farm.

Men and Women are Equal

Mathematical understanding is a concern for this study with regard to its usefulness regarding STEM majors and due to the aforementioned gender-bias issues concerning math. Asking our focus groups about their understanding of math to see if this gender-bias is present has importance as it demonstrates the generalizability of Bohannon's (see above) work. Of the forty-five female subjects, only six confidently said they have a good understanding of math. Four students said "maybe" and the rest said they do not have a good understanding of math. Due to the fact that it is generally believed that men are better than women at math, it was not a surprise to see the lack of mathematical

confidence in our focus group matched that which the numbers indicate. Since we know that there is little difference between men and women's math skills it also seems important to see if our focus groups hold a gender-bias regarding math skills. Twenty-eight participants felt that men are not better at math and science.

Another factor to consider with the math understanding findings is that its perceived usefulness may not be apparent to the participants. This is similar to how they may not see the usefulness of STEM degrees in regards for social concerns and care of others (Margolis & Fisher, 2002).

Stereotypes Die Hard

Part of the challenge of increasing the enrollment for women in STEM degree program lies in the fact that many students do not actually know what someone with an IT or IST degree does after college. True to our expectations, many of the participants in our study simply did not know about the opportunities available to IST graduates. The participants that provided responses other than "no" seemed to have only a vague idea about IT and IST. When asked to respond to question number 7 (what do you think a person with an IT or IST degree does after college?) Participant twenty-four answered, "Don't they come and fix computer problems like our people down the hall?" It seems that students in our participant group feel that information systems and technology is mostly tied to fixing computers and doing maintenance. Other responses to the question of what one does with an IT degree included: research, GPS technology, database management, and even Geek Squad. This shows us that most participants in our focus groups do not have a clear idea of what IT and IST people do after college and demonstrates that the lack of understanding of IT and IST could be a major factor as to why women are not choosing STEM degrees.

More Stereotypes

Since gender-bias and general misunderstandings about STEM seem prevalent, we felt that it seemed logical to ask the focus group participants if they felt that certain majors are predominately male or female. (Marks, 2015). Empathy and the caring for others clearly are factors for our participants reasoning for why they feel majors are predominately male or female.

Our focus group participants do feel STEM degrees are predominantly male. At the top of the list, in terms of programs that have the most male students are Engineering and Aviation, with ten participants specifically naming these majors. Three participants said STEM degrees in general are male dominated. Other responses to the question of which majors were particularly male dominated included automotive, accounting, and medical school.

Although not every response was accompanied by a reason, here are some of the factors that participants felt contribute for these fields to being male dominated. Many participants felt that engineering is hands-on, math oriented, and is more of a "male thing". Another factor they cited is that these type of degrees are more popular with men because of men's stereotypical role as "problem-solvers".

Female Students Lack Interest and Knowledge

When the participants were asked why they thought there was a low enrollment of women in IT, the majority of the participants gave answers that suggested that there was a lack of interest. Participant three stated, "Women aren't interested in computers." Number eight said, "Guys are more into IT than women." Participant thirty-five answered, "They are not interested in how computers work or want to build one." In total, twenty-one of the forty-five participants also felt that women just were not interested in STEM careers.

Other responses indicated that participants felt t that girls were discouraged from doing anything with science and math, that girls were not really taught about these topics in school, or they that they just didn't even know the program existed. Participant thirty-seven answered, "I feel like a lot of guys grew up playing video games and girls don't as much." Fessenden's article in *Smithsonian* magazine concluded that in the last twenty-five years, computers have come to be categorized as "boy toys". When boys grow up around playing with machines they have a familiarity that women don't, giving them the upper hand (Fessenden, 2014).

DISCUSSION

Helping people is a recurring topic when female students are asked to explain why they chose their major. This corroborates the literature which concludes that major selection is often linked to gender stereotyping as wanting to help people IS a gendered stereotype that affects women. Women are raised to "want" to help others, and we raise men to want to hold positions of power. The literature also determined that many women base their abilities and choices on what they were told they could do at a young age. A lot of our focus group participants seemed to feel that women are more empathetic and can care for others better than men which also indicates gender stereotyping.

Since "caring for others" seems to be the most important factor for many of the women's' decisions about their choice of major, it is a shame that it can be hard for the participants to see the direct benefit that a STEM career can have towards the help and care of others. An older study shows us that women who choose STEM degrees or careers want to link their computing skills for social concerns and caring for others (Margolis & Fisher, 2002).

Corbett, Hill and Rose found that the environment women grow up in is the key to their achievements. They believe that stereotypes can lower a girl's aspirations for STEM careers (Corbett, Hill, & Rose, 2010). If there was more of an overview of the benefits of STEM careers included in introductory courses, more female faculty, and improvements in departmental culture, researchers believe that it would help increase the interest of female students (Corbett, Hill, & Rose, 2010).

The literature review revealed, that the choice of major is mostly influenced by the student's personal interests. This is particularly interesting in light of the fact that only five out of forty-five participants claimed interest as their primary reason for choice of major. This could be lumped into the "helping others" theme easily as "helping others" can be considered an interest that the participants consider when choosing majors.

Since studies reveal that women and men are about equal in mathematical ability, it might be surprising to discover that society generally believes that men are better at math than women. Our focus groups reveal this gender-bias towards math is present within the demographic represented by our participant groups. Only six out of forty-five female participants are confident with regard to their math skills. It is hard to say if this is true because of a perceived lack of skill, lack of interest, or if it related to believing the stereotype. It is also interesting to note that although only six female participants feel confident with math, twenty-seven of the participants do not believe that men are better than women concerning math and science skills. It appears the gender-bias is present in some but at least not in all participants.

Another concern that arose from the focus group analysis is that women do not know what IT and IST students actually do after college. Most of our participants have no idea. Some think that graduates simply fix computers. Other responses included database management, GPS technology, and working for Geek Squad. Part of this problem lies in the lack of knowledge of the field as nobody mentioned programming, networking, or even project management which are common to the field.

With regard to technology programs, one participant provided interesting reasoning for women's lack of interest, saying that "it seems manly, and mainly male students enroll" in information technology programs. This is interesting because we asked participants if they would be discouraged from pursuing a degree in a major that had fewer females enrolled and the question received a unanimous "no". This came as a surprise due to research that suggests that female students are turned off by STEM classes as they commonly feel like outsiders in a male-dominated class (Margolis & Fisher, 2002).

IMPLICATIONS AND LIMITATIONS

This was a pilot study, conceived to determine if there really is a gendered difference in the way that male and female students choose their career paths. The study was quite limited in a number of ways, including the number

of participants, the participant sampling, and the demographic information that was collected. A future, more comprehensive study would include a much larger, more diverse sample, and would include demographic questions in the instrument in order to ascertain whether there are additional factors that might influence female students' choice of major.

In order to gain a more diverse population of IT professionals for the upcoming jobs, awareness about careers in technology needs to be raised, particularly at earlier stages in students' education. Our study and others have found that there are so many women that do not know what a career as an IT professional might entail. With the industry growing as quickly as it is, it is imperative that we start teaching girls at a younger age the skills necessary for the technical world will allow them to help others. Not only do we need to teach them the skills, however, but we need to teach them the value inherent in STEM careers and the opportunities that are present. In a word, science careers need to be rebranded as meeting the interests and abilities of young men AND young women. It goes without saying that gender stereotypes should be discouraged when it comes to advising students and picking classes, at both the high school and secondary school levels. We need to reinforce the fact that men and women are equal in their intelligence and their ability to be successful in STEM programs. Further research should be done to gain a better understanding of how to go about making these changes, in both the fields of education, and teacher education, and in the areas of science, technology, engineering and mathematics. What would make girls more interested in STEM careers, what would ignite their passion, given what we know about women's career goals?

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Appendix A

WHAT IS YOUR MAJOR?

Persons 1-34: Dental Hygiene

35, 37, 42: Health Care Management

36: Sonography

38: Sports Administration

39: Hospitality and Tourism

40: Exercise Science

41, 43: Agriculture Business

44: Radiology

45: Fashion Styling