
AC 2012-3989: PK-12 COUNSELORS KNOWLEDGE, ATTITUDES, AND BEHAVIORS RELATED TO GENDER AND STEM

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PK-12 Counselors Knowledge, Attitudes, and Behaviors related to Gender and STEM

Abstract

Given the disparity of women entering engineering and other STEM occupations, it is imperative for counselors to have the correct knowledge, attitudes and behaviors (KAB) to effectively contribute to the closing of this tremendous gender gap. In addition, PK-12 counselors have a responsibility to introduce students to all types of careers, and should be prepared to help students plan for these types of careers, particularly through course selection. Therefore, it is important for us to not only understand the role of counselors, but to have a better grasp of their KAB regarding gender and STEM, and how this may potentially influence how they counsel and engage with students.

This paper examines the results of a five point Likert scale assessment tool developed using the KAB framework. The survey was administered as a pre and post assessment from a two hour professional development workshop on STEM occupations in November of 2010. Participants included 120 counselors from a large Southwest school district. Eleven out of the original 45 survey items are reviewed in this paper and $N=71$ participant surveys are included in this report. The purpose of this particular study (11/45 survey items) is to examine counselor's knowledge, attitudes, and behavior related to gender and STEM.

The results from this study show the counselors already know that females are underrepresented in STEM occupations and are negatively affected by stereotypes, likely due to a similar required workshop and associated initiatives in 2008 at the same district. The workshop intervention did, however, strengthen their behavioral agreement response. The counselors do not share the stereotypical attitude that girls are not as good as boys at math and science; however, the majority of counselors acknowledged the stereotype that science, math, and engineering are considered masculine. This exemplifies that counselors acknowledge the bias, but do not explicitly translate the bias to girls' achievement. Allowing students the greatest trajectory towards an engineering occupation requires advanced math and science coursework selection beginning in middle school. After the workshop, counselors were more likely to encourage students to choose math and science coursework than before, indicating they accept the importance of career counseling as it is applicable in coursework selection.

In order to develop effective professional development workshops or informational curriculum for PK-12 educational counselors, it is important to understand their knowledge, attitudes, and behaviors. Assessments like presented in this report can help inform workshop curriculum development to meet the needs of the counselors, in order to better prepare them to influence student's decisions to consider and pursue careers in engineering. The data from this initial analysis will aid in future improvements to the assessment, and potential tool validation.

Keywords: PK-12 counselors, STEM, engineering, gender, diversity, professional development

Introduction

U.S. Department of Labor workforce projections for 2018 highlight that nine of the 10 fastest-growing occupations requiring at least a bachelor's degree will necessitate significant scientific or mathematical training (National Science Board, 2010). The United States' science, technology, engineering, and math (STEM) workforce is aging while jobs requiring specialized training are growing at five times the rate of other occupations (American Association of University Women, 2010; National Science Board, 2010). STEM workers, who use science and math to solve problems, are needed to replace the many highly skilled workers who will retire over the next decade. A heterogeneous and culturally diverse workforce creates competitive advantage through greater creativity and innovation, and increased quality of team problem solving based on multiple perspectives (American Management Association (AMA), 1998; Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000; Robinson & Dechant, 1997). Therefore, in order to sustain US capacity and increase global competitiveness for technological innovations, it is essential for people from a diverse representation of cultures, ages, and gender to enter STEM occupations.

Since 2000, women have earned approximately half of all science and engineering bachelor's degrees (NSF, 2007). However, further examination reveals that there is a significant gender gap in the number of women earning engineering degrees. Remaining nearly stagnant over the last fifteen years, women today represent only 17.8% of bachelor's degrees awarded in engineering, and a diminutive 10.7% of the engineering workforce (NSF, 2009). In order to effectively compete in the global marketplace, it is imperative that we advance the full and equitable participation of all Americans in science, engineering, and technology fields. The diverse viewpoints, approaches, and skills of women will benefit these high-tech industries, and in turn, positively affect our economy (Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000).

Aggressive and focused intervention efforts targeting women is recommended to address the gender gap in engineering (Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000). While girls take more science and math classes and make better grades than boys, they are not readily choosing engineering as a college major and career path. Areas where consistent gender differences have emerged are children's and adolescents' interest in math and science, their beliefs about their abilities in math and science, and their perceptions of the importance of math and science for their futures (Halpern et al., 2007). Acknowledging and addressing these areas can increase girls' awareness, interest, and confidence to pursue a career in engineering.

The 2010-11 U.S. Bureau of Labor Statistics Report describes educational counselors as responsible for, among many things, operating career information centers and career education programs in order to promote the career development of children and youth (Bureau of Labor Statistics). The American School Counselor Association's National Standards (standard A in the area of career development) explicitly states: "Students will acquire the skills to investigate the world of work in relation to knowledge of self and to make *informed* career decisions (American School Counselor Association, 2004, emphasis added)."

Education research shows that K-12 educators and students generally have a poor understanding of what engineers look like and do (Cunningham, 2009; Cunningham, Lachapelle, & Lindgren-Streicher, 2005). Not only are there numerous misconceptions of engineering as a discipline, but educators tend to be very anxious to the barriers they identify between themselves and engineering. With no background to know how to converse with students about who designs technology and how they do it, educators can feel very strong barriers that limit their contribution to the development of future technical talent (Akerson & Hanuscin, 2007). Professional development workshops designed to break down these barriers can enable counselors to have a greater impact on students' awareness, interest, and confidence to pursue engineering (Ross, 2011). This increased investment in education will boost U.S. global competitiveness (Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000).

Theoretical Background

To understand the landscape of PK-12 students and their propensity for engineering, the following literature review examines student achievement in math and science, awareness and interest in technical careers, confidence, and environmental factors that may play a role in student career choice. The theoretical framework presented in this section is the basis of a survey development of associated counselors' knowledge, attitudes, and behaviors.

Achievement

Regardless of stereotypes that boys are better at math and science, on average, females receive higher grades in school in every subject including mathematics and science; females earn more credits in math and science courses than boys; and female high school graduates have a higher combined GPA in math and science courses than boys (Dwyer & Johnson, 1997; Kimball, 1989; Shettle et al., 2007; U.S. Department of Education - National Center for Education Statistics, February 2010). Despite this achievement, boys tend to slightly outscore girls when tested on the same content in high-pressure situations, such as the SAT, NAEP, PISA and TIMSS exams (College Board, 2010; Gonzales et al., 2009; Organisation for Economic Co-operation and Development, 2006; U.S. Department of Education - National Center for Education Statistics, 2007, February 2010). While more females are participating in Advanced Placement mathematics and science, they are not performing at the levels of their male counterparts (D. M. Campbell & et. al., 2009). In 2009, 55 percent of AP test-takers were girls, but in STEM-related areas girls represent only 41% of test-takers (College Board, 2009). In the same year, 38 percent of AP physics test-takers were girls, and girls made up only 19 percent of those taking AP computer science (Hill, Corbett, & St Rose, 2010).

The foundations and explanations of gender differences in math skills remain unclear, as competing sides of the literature have yet been able to undeniably prove their positions on why female achievement in math and science high stakes exams trail behind males (D. M. Campbell & et. al., 2009; Gibbs, 2010). It is suggested that girls will perform at the same level on high-stakes testing as their male classmates when they are encouraged to succeed, are given the necessary educational tools, and have visible female role models excelling in mathematics (Else-Quest, Hyde, & Linn, 2010).

Awareness

In a nation that was seeded by freedom and opportunity, the roots of the United States of America are grounded by hard work, innovation, and determination. Most often through identification with a worker, ages 5 to 10 is the stage of life when the concept of working becomes ingrained in the child's conception of his or her adult life(Havighurst, 1964). Immersed in a society that is dominated and driven by work, and vulnerable to social influences of prestige and gender bias, children as young as five years of age begin to postulate what career they will one day have(Gottfredson, 1981). Young people tend to choose professions that are familiar(Parker & Jarolimek, 1997), whether traditions in their family, or professions that have been exposed to them through education and experience. Young children can begin to gather information about careers and acquire the skills and competencies that will one day support success in the workplace(P. Duffy, 1989). Counselors play a large role in student career exploration (American School Counselor Association, 2004).

A strong high school background, particularly in math, is "key to overall success in college" (P. Campbell, Jolly, Hoey, & Perlman, 2002). Pre-college courses that have the strongest impact on a student's postsecondary education are high level mathematics courses in high school, according to Clifford Adelman: "Finishing a course beyond the level of Algebra II more than doubles the odds that a student who enters postsecondary education will complete a bachelor's degree" (Adelman, 1999). Math skills are considered essential to success in STEM fields(Hill, et al., 2010).

One out of every two middle school students indicate that they do not plan to take mathematics and science courses beyond what their schools require. Signaling a lack of awareness of course requirements for potential high-tech career trajectories, the same students indicate that they would be interested in going to college, and taking college-level mathematics courses(Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000). This contrast heralds that students do not understand the importance of, and requirements for, taking rigorous mathematics and science courses in high school, pointing to the importance of encouraging exploration of a wide array of career trajectories so that students do not inadvertently build roadblocks to certain careers(Rudasill & Callahan, 2010; White Paper prepared for U. S. Secretary of Education Richard W. Riley, 1997). Given this, it is imperative for counselors to be prepared to counsel students about careers and how to prepare for these careers via their coursework.

Students generally have a poor understanding of what engineering is and what engineers do(Cunningham, et al., 2005; Knight & Cunningham, 2004), and females lack the role models necessary to envision themselves in this field(Else-Quest, et al., 2010; Fancsali, 2002; Huber & Burton, 1995). Girls are attentive to the behaviors that women in their culture engage in and thus feel efficacious in and model those behaviors(Else-Quest, et al., 2010). Girls' attitudes regarding scientists and engineers have been influenced by the lack of female scientists in the media. With this absence of role models, many girls tend to view science and technology an unsuitable career choice and personally irrelevant to their lives. By concerted efforts to expose students to careers in science and engineering, these perceptions can be reversed(Huber & Burton, 1995). Career awareness and having a sense of similarity to the people in a field is an important predictor of interest in that field(Cheryan & Plaut, 2010).

Interest

About 80% of fourth graders report positive attitudes toward mathematics and science compared to an estimated 33% of eighth graders (Sherman, Honegger, & McGivern, 2003). Despite gender similarities in achievement, boys reported more positive math attitudes and affect, and were more extrinsically and intrinsically motivated to do well in math than were girls (Else-Quest, et al., 2010; J. S. Hyde, Fennema, Ryan, Frost, & Hopp, 1990). Studies show that students begin to lose interest in science, technology, engineering, and math by junior high school (Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000), and from early adolescence girls express less interest in science or math careers than boys (Lapan, Adams, Turner, & Hinkelman, 2000; Turner et al., 2008; Turner & Lapan, 2005). A report by the Commission on the Advancement of Women and Minorities in Science, Engineering and Technology says that there are four points in life at which girls and women seem to lose interest in these subjects: as they enter middle school, late high school, college and graduate school, and in their professional lives (Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000).

A 2009 poll of 8-17 year-old students found 24 percent of boys but only 5 percent of girls showing interest in an engineering career (Hill, et al., 2010). Females are more likely than males to want to pursue a career in the area of health, or professional or managerial jobs, choosing occupations that place a greater emphasis on working with people and contributing to society (Ashby & Schoon, 2010; R. Duffy & Sedlacek, 2009; Jones, Howe, & Rua, 2000; Simpkins & Davis-Kean, 2005). Positive experiences in high school serve as the most consistent and important predictors of students future interest in science (Tolley, 2003). Girls are more likely to choose courses and careers in math and science if their interest in these fields is sparked and cultivated throughout the school years (Wigfield, Eccles, Schiefele, Roeser, & Davis Kean, 2006) (as referenced by (Halpern, et al., 2007; Page, Bailey, & Van Delinder, 2009)).

Confidence

Beginning at an early age, girls report less confidence in their math ability than boys do, even when no actual difference in math achievement exists (Herbert & Stipek, 2005; Pajares, 2005). Fouad (2008) claims girls' feelings of self-confidence are a precursor to girls' interests in science and math (Fouad, 2008). Students who lack confidence in skills they possess are less likely to engage in tasks in which those skills are required, and they will more quickly give up in the face of difficulty (Pajares, 1996).

According to the Eccles et al. Expectancy Value Model, two of the key factors adolescents contemplate when making a decision are their self-concept of their abilities in an area and how much they value an area (Eccles, 1994). Simpkins & Davis-Kean found that differences in adolescents' high school choices date back to their self-concepts and values in ninth grade, however, a high self-concept is the important determinant of course selection rather than the unique combination of high self-concept and high values (Simpkins & Davis-Kean, 2005). Thus students with more confidence in their math and science abilities are more likely to excel in these subjects and pursue coursework and careers in these fields.

Gender stereotypes about gender roles and math may encourage girls to feel anxious and less confident(Steele, 1997). Else-Quest (2010) postulates:

When girls develop in a societal context where women have careers in scientific research, they receive a clear message that STEM is within the realm of possibilities for them. Conversely, if girls' mothers, aunts, and sisters do not have STEM careers, they will perceive that STEM is a male domain and thus feel anxious about math, lack the confidence to take challenging math courses, and underachieve on math tests. (p. 123)

Relating this to the expectancy-value model, Else-Quest's theory supported by empirical data is: if a girl believes that the career opportunities available to or appropriate for women do not require mathematics skills, she is less likely to capitalize in the development of her mathematics skills, thus identifying math as less useful or valuable and believing she is not capable of doing math (Eccles, 1994; Else-Quest, et al., 2010; Frome & Eccles, 1998). This theory provides a clear model for why cultural inequities and biased environmental factors in educational or career opportunities have an adverse impact on girls and women considering STEM careers(Cheryan & Plaut, 2010).

Environmental factors

In a study engaging in the debate of biological versus environmental factors instigating the underrepresentation of women in STEM, it was found that men have higher mean TIMSS scores in all of the countries examined, but the size of these differences between men and women varies considerably, evincing the importance of environmental factors, whether parental, sociocultural, or educational(Andreescu, Gallian, Kane, & Mertz, 2008; Penner, 2008). Strong implicit biases associated with gender and science influence early socialization and perpetuate gender stereotypes. These attitudes and messages skew girls' academic pathways early, placing them on a trajectory which may limit future career options due to insufficient course foundations.

A comprehensive review of the research on sex differences in math showed evidence that children conceptualize mathematics and science as a "masculine" activities(Jones, et al., 2000; Shettle, et al., 2007). This is not hard to imagine when 70% of more than half a million Implicit Association Tests completed by citizens of 34 countries revealed implicit stereotypes associating science with males more than with females(Nosek et al., 2009). In a study by Sadker and Sadker examining stereotyped perceptions, the most strongly endorsed gender-biased statement (for boys, girls, mothers, fathers, coaches, and teachers) was, "Men are naturally better at mathematics than women." In contrast, the most strongly endorsed non-biased statement was, "It is just as appropriate for women to study mathematics as for men"(Sadker & Sadker, 1994). Herein lies the social conflict: "women and men should have equal opportunities for success in math, even though men have more natural talent than women" (Leedy, LaLonde, & Runk, 2003) (p. 289). Implicit stereotypes and sex differences in science participation and performance are mutually reinforcing(Nosek, et al., 2009).

Unsupportive, biased classroom environments and outdated pedagogy inhibit women's participation in STEM subjects(Fancsali, 2002). Leedy found that even girls who are particularly motivated and talented in mathematics are not immune to the ill effects of gender bias, as they too experienced decreased confidence in math(Leedy, et al., 2003). Schools disrupt female math

trajectories by institutionalizing gendered expectations that work to discourage girls' pursuit of math-related skills (Sadker & Sadker, 1994). Consequently, popular literature that emphasizes gender differences may in fact reinforce stereotypes that girls lack mathematical and scientific aptitude (J. Hyde & Linn, 2006). Environmental factors are at work, and gender equity in education is important not only for girls' math achievement but also for girls' self-confidence and valuing of mathematics (Else-Quest, et al., 2010; Pajares, 1996).

Purpose of the study

The previous review of the literature presents a theoretical framework for this study. Student achievement, awareness, interest, and confidence in math and science, and thus career choice, are, to some degree, at the liberty of environmental factors. This complex intersection is a minefield for researchers aiming to increase the number of students entering engineering and to close the gender gap in this field. PK-12 counselors have a responsibility to introduce students to all types of careers, and should be prepared to help students prepare for these types of careers, particularly through course selection. It is important for us to understand not only understand the role of counselors, but to have a better grasp of their knowledge, attitudes, and behaviors (methodological framework discussed in the methods section) regarding gender and STEM, and how this may potentially influence how they counsel and engage with students. The purpose of this study is to examine counselor's knowledge, attitudes, and behavior related to gender and STEM.

Research Questions

The specific questions guiding this study are the following:

- 1) Do PK-12 counselors believe that girls can achieve equally as well in math and science as boys?
- 2) Do PK-12 counselors encourage students to choose math and science coursework?
- 3) Do PK-12 counselors know that females are underrepresented in STEM occupations, and are negatively affected by stereotypes?
- 4) Do PK-12 counselors share attitudes that science, engineering, and math are considered masculine?

Method

Increases in knowledge, such as that acquired at professional development workshops, are associated with greater influence of attitudes on behavior (Fabrigar, Petty, Smith, & Crites, 2006), and researchers are not only concerned with evaluating change (such as in knowledge and attitude) but with predicting behavior. In a 2004 publication, Scrader and Lawless summarize the efforts of "a growing body of researchers from different areas [that] have ventured to adapt Bloom's taxonomy of instructional objectives into a multi-construct approach to assessment that evaluates not only knowledge, but attitude and behavioral change as well (p. 8)." They found that the most common examples of the knowledge, attitude, and behavior (KAB) approach arise from the medical literature examining a range of areas from primary care to AIDS prevention (e.g., Miller, Booraem, Flowers, & Iversen, 1990), all efforts to measure change. The KAB approach is meant to explore "the relationships among variables that can be used to indicate complex human processing in various environments," and thus proves to be "one promising

method for examining such changes and isolating the outcomes that will lead to instructional improvement in any arena of human performance” (Schrader & Lawless, 2004).

Survey Construction

The complete survey consists of 45 questions based on the knowledge, attitudes and behaviors (KAB) framework. Only 11 questions are analyzed in this report (see Appendix, Table 7). Two questions targeted participant *knowledge* of female underrepresentation in STEM occupations, and negative stereotypes influencing girl’s aspirations for STEM careers. Six questions addressed participants’ *attitudes* of implicit bias for gender in engineering, science, mathematics, and liberal arts, and their belief of girls’ ability to achieve equally as boys in math and science. Three questions inquire of participant *behavior* in counseling boys and girls to choose math and science courses, and likelihood of encouraging females to consider STEM occupations. These questions were informed by the research, and chosen to quickly assess PK-12 counselors’ ideas of gender and bias related to STEM. Each question was assessed via a five point Likert scale where 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; and 5 = Strongly Agree, a method similar to that used by other researchers (Heppner, Humphrey, Hillenbrand-Gunn, & DeBord, 1995; Miller, et al., 1990).

Survey Administration

The survey was administered as a pre and post assessment (Byrd-Bredbenner, O’Connell, & Shannon, 1982; D. T. Campbell & Stanley, 1963; Kapoor, 1989) of a group of counselors from a large Southwest school district who were required to attend a two hour professional development workshop on STEM occupations. Approximately 120 counselors were present for the workshop, but only $N=71$ are included in this report. This was the amount of participants who completed both pre and post assessments. Institutional Review Board exempt research approval for this research study was made available through Purdue University. The initial administration of this survey addressed in this paper served as a pilot test of the tool.

Participant Sample

The sample for this study consisted of PK-12 counselors, and 94.7% are female. Fifty one percent are elementary counselors (PK-5), 34% are middle school counselors (6-8), and 13% are high school counselors (9-12). The majority of counselors (51%) have between 3 and 9 years of experience. Fourteen percent were new counselors with zero to two years of experience, 24% have between 10-15 years of experience, 8% have 16-20 years of experience, and 3% have more than 20 years of PK-12 counseling experience. Additionally, 64% of the counselors in this study attended a workshop in 2008 taught by the same instructor entitled, *What is Engineering?*.

Results & Discussion

The results presented in this report are simply descriptive statistics. This instrument is not yet a validated assessment tool, though this work will hopefully inform a validated instrument in the future through further analysis.

Gender Concept

Seven questions assessed the gender and STEM concept across the KAB framework. Each of these items was specifically addressed during the workshop and it was intended that these ideas were major themes that acted as a unifying thread throughout the workshop.

Attitudes

Assessing first their attitudes, the counselors overwhelmingly agreed that girls can achieve equally well in math and science as boys (Table 1). There was no statistical difference from the pre to post assessments, with minimal standard deviation. This indicates that the counselors believe that there is no gender difference in math and science achievement.

Table 1 Descriptive Statistics: Girls can achieve equally well in math and science as boys

| | Pre (Mean) | Pre (StdDev) | Post (Mean) | Post (StdDev) |
|---------|------------|--------------|-------------|---------------|
| Math | 4.68 | .50 | 4.72 | .48 |
| Science | 4.69 | .49 | 4.72 | .48 |

Behaviors

Prior to the workshop, counselors were not more likely to encourage females than boys to pursue a STEM career (Median 3, mean 3.01, SD 0.85). However, after the workshop, counselors were more likely to encourage girls than boys (Median 4, mean 3.57, SD 1.05). Not as significant as hoped, but perhaps counselors recognized throughout the course of the workshop that females need more encouragement to pursue STEM occupations. The wording of the question may be misleading, promoting a strong bias towards female, whereas the next two questions (Table 7 questions 4-5) balanced out the suggested bias. Prior to the workshop, counselors were almost equally as likely to encourage boys & girls to choose math and science coursework, though more likely to encourage both after the workshop (Table 2). This indicates that counselors received the message that students need additional counseling and encouragement to choose math and science courses. Middle school teachers were more likely than elementary or high school counselors to encourage females to choose math and science courses prior to the workshop (Table 3). During middle school, students begin to make choices of which math and science trajectory to pursue. The delta shown here may simply be described by the notion that middle school counselors are aware of the importance to encourage students, particularly females, to make good course selection choices early in their education. Counselors with greater than 10 years of experience were more likely to encourage boys and girls to choose math and science than those with less than 10 years. Experience is invaluable; however professional development can influence counselors. Counselors who attended the 2008

Engineering workshop were more likely to encourage boys and girls to choose math and science courses than their colleagues who did not attend the previous (2008) workshop.

In designing the survey, it was not anticipated that the counselors’ behaviors would change from pre to post assessment for questions 4 and 5 (Table 7). The questions were worded in present tense (i.e. “I encourage...”). The implications of the pre/post delta suggest that the questions should be altered to accurately assess behavior, present or future likelihood.

Table 2 Descriptive Statistics: I encourage boys/girls to choose math and science classes

| | Pre (Median) | Pre (Mean) | Pre (StdDev) | Post (Median) | Post (Mean) | Post (StdDev) |
|-------|-----------------|---------------|-----------------|------------------|----------------|------------------|
| Boys | 3 | 3.48 | 1.12 | 4 | 4.05 | .8 |
| Girls | 4 | 3.65 | 1.01 | 4 | 4.17 | .74 |

Table 3 MS Counselors are more likely to encourage females to choose math and science classes

| Level | Mean | Std Dev |
|---------------|------|---------|
| Elementary | 3.70 | 0.97 |
| Middle_School | 4.25 | 0.71 |
| High_School | 3.85 | 0.99 |

Knowledge

Assessing counselor knowledge, prior to the workshop counselors knew that females were underrepresented, but were more aware after the workshop (Table 4). After the workshop, counselors were slightly more likely to agree that stereotypes can lower girls’ aspirations for STEM careers (Table 5). These questions assessed two important messages of the workshop. Counselors who attended the 2008 workshop were more aware initially that females are underrepresented in STEM occupations.

Table 4 Descriptive Statistics: I know that females are underrepresented in STEM occupations

| | Median | Mean | StdDev |
|------|--------|------|--------|
| Pre | 4 | 4.37 | .73 |
| Post | 5 | 4.61 | .52 |

Table 5 Descriptive Statistics: I know that stereotypes can lower girls' aspirations for STEM careers

| | Median | Mean | StdDev |
|------|--------|------|--------|
| Pre | 4 | 4.39 | .59 |
| Post | 5 | 4.64 | .51 |

Bias Concept

Four questions assess the counselors' attitude of bias regarding gender and engineering, science, mathematics, and liberal arts. These questions were modeled after the Implicit Association Test (Nosek, et al., 2009). During the workshop, these ideas were introduced through the discussion of stereotypes, though these stereotypes were challenged. Counselors agreed that most people perceive engineering, mathematics, and science as masculine and disagreed that language arts is perceived as masculine. This specifically aligns with Nosek's findings through the Implicit Association Test.

Table 6 Descriptive Statistics: Gender Bias (Rating 5 perceived as masculine)

| | | Median | Mean | StdDev |
|--------------|------|--------|------|--------|
| Engineering | Pre | 4 | 3.97 | .69 |
| | Post | 4 | 4.29 | .69 |
| Mathematics | Pre | 4 | 3.57 | .88 |
| | Post | 4 | 4.22 | .76 |
| Science | Pre | 4 | 3.52 | .90 |
| | Post | 4 | 4.16 | .82 |
| Liberal Arts | Pre | 2 | 1.94 | .54 |
| | Post | 2 | 2.48 | 1.11 |

May it be noted that no significant variations in these questions were identified by participant's gender, perhaps merely limited by the population.

Conclusion

It is the role of educational counselors to introduce and prepare students for their future career (Bureau of Labor Statistics). Given the disparity of women entering engineering and other STEM occupations, it is imperative for counselors to have the correct knowledge, attitudes and behaviors to effectively contribute to the closing of this tremendous gender gap.

The results from this study clearly showed that counselors do not share the attitude aligning with the stereotype that girls are not as good as boys at math and science, despite the fact that they do acknowledge the stereotype that science, math, and engineering are considered masculine. This exemplifies that counselors acknowledge the bias, but do not translate the bias to girls' achievement. From this study, it is unclear how this correlates to career counseling. Future work, or simply revision to the assessment, may allow this sort of connection to be considered. The counselors already knew that females are underrepresented in STEM occupations, and are negatively affected by stereotypes, but the workshop intervention did strengthen their agreement response.

Allowing students the greatest trajectory towards an engineering occupation requires advanced math and science coursework selection beginning in middle school. After the workshop, counselors were more likely to encourage students to choose math and science coursework than before, indicating they accept the importance of career counseling as it is applicable in coursework selection. Counselors who attended the 2008 workshop were more aware initially that females are underrepresented in STEM occupations and were more likely to encourage boys and girls to choose math and science courses than their colleagues who did not attend the workshop, indicating a workshop intervention addressing these topics contributes to counselor knowledge, attitudes, and behaviors over time.

In order to develop effective professional development workshops for PK-12 educational counselors, it is important to understand their knowledge, attitudes, and behaviors. Assessments like presented in this report can help inform workshop curriculum development to meet the needs of the counselors, in order to better prepare them to influence student’s decisions to consider and pursue careers in engineering.

Appendix

Table 7 Assessment Questions, Concept & KAB

| | Concept | KAB | Survey Question |
|----|---------|-----|--------------------------------------------------------------------------------|
| 1 | Gender | A | Girls can achieve equally well in math as boys |
| 2 | Gender | A | Girls can achieve equally well in science as boys |
| 3 | Gender | B | I am more likely to encourage a girl to pursue a STEM career than a boy |
| 4 | Gender | B | I encourage boys to choose math and science classes when selecting coursework |
| 5 | Gender | B | I encourage girls to choose math and science classes when selecting coursework |
| 6 | Gender | K | I know that females are underrepresented in STEM occupations |
| 7 | Gender | K | I know that stereotypes can lower girls' aspirations for STEM careers |
| 8 | Bias | A | Most people perceive engineering as masculine |
| 9 | Bias | A | Most people perceive mathematics as masculine |
| 10 | Bias | A | Most people perceive science as masculine |
| 11 | Bias | A | Most people perceive the language arts as masculine |

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