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Wendy Bibeau

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2014

Abstract

Educators' Perspectives on Female Students' Enrollment in Computer Science and Engineering

by

Wendy Bibeau

MS, Southern New Hampshire University, 1995

BS, University of Massachusetts, Lowell, 1991

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

July 2014

Abstract

The purpose of this case study was to inquire into educators' perspectives on female students' enrollment in computer science and engineering (CSE) courses. At a high school in New England, girls are significantly underrepresented in CSE courses, a problem that is reflected in schools throughout the United States. As a result, these careers are lacking in input from women, even as the number of CSE professions is increasing. Research questions in this study addressed what teachers, administrators, and guidance counselors think about this growing problem and what changes, if any, they are willing to make to help close this gender gap. Individual interviews and a focus group were used to gather data from 7 participants. The theoretical framework was based on brain research and social theories. Data were then analyzed and coded for themes based on the framework. The results indicated that educators are cognizant of the underrepresentation within their school and have tried individually, but unsuccessfully, to make changes to increase the numbers of girls in CSE courses. In response to these findings, a professional development project was developed that outlines ways for educators to communicate and collaborate to increase girls' representation in CSE courses. Girls, schools, and industry can benefit from the results of this study. If educators can encourage more girls to take CSE courses and provide support for them to be confident and successful, then more girls will go on to major in CSE, which will then lead to an increase in the number of women working in these fields.

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Section 1: The Problem

This project study focused on the lack of girls in computer science and engineering (CSE) courses as well as the lack of effort within schools to increase the number of girls in these courses. The intent of this study was to determine what educators' perspectives are on female students' enrollment in CSE courses, if they are willing to advocate for change, and if they know or have tried techniques that may encourage more girls to participate in these courses.

Definition of the Problem

At a regional high school of about 1,500 students in a suburb in New England, girls are significantly underrepresented in CSE courses. Computer courses that are offered through the business department, such as computer applications, desktop publishing, and web design, have about an equal number of boys and girls enrolled in them. The same is not true for Visual Basic, C++, Java, Flash, AutoCAD, and gaming courses, which are more math-based courses that deal with problem solving and writing code. Only 24 girls (16%) at the high school are currently enrolled in Visual Basic, C++, Java, Flash, AutoCad, and gaming compared to 126 boys.

Not all computer courses are considered computer science. At the high school in this study, the math department offers all programming courses while the business/technology department offers the rest of the computer courses. In addition,

engineering courses are offered through the engineering division of the business/technology department but are considered a separate entity.

One goal of the district is "to prepare our students to the best of our ability to succeed in the workplace, or in higher education, by providing them advanced technology skills." This goal needs improvement in the area of CSE courses at the high school because overall enrollment is low, and most students in these courses represent only one gender. Educators in the school, including teachers, guidance counselors, and administrators, have an obligation to all students to provide encouragement and support. Lack of knowledge and effort on the part of the educators has perpetuated the underrepresentation of girls in CSE courses. The purpose of this study was to explore how educators feel about the inequity in the number of girls and boys in CSE courses, why they think it exists, and what they think they can do to increase the number of girls enrolled in these courses. Understanding why educators have not done more to encourage girls in CSE is the first step to changing this trend.

As information technology jobs increase, the number of women in these fields decreases. From 1983 to 2008 the percentage of women in the information technology workforce went from 43% to 26%, according to the U.S. Bureau of Labor Statistics Current Population Survey (as cited in Coder, Rosenbloom, Ash, & Dupont, 2009). As more men continue to work in and influence this profession, the technology they create is not as heterogeneous as it could be. Technology benefits from diversity because differences and varied experiences promote creativity (Papastergiou, 2008). Ideas and

views from a diverse workforce create an end product that may interest many consumers, as well as potential employees.

Schools need to make more of an effort to change the stereotype that CSE courses and professions are for boys. More needs to be done to expose and encourage more girls to participate. Girls may gain the self-confidence needed to enter into CSE courses and careers if these interventions are done early enough. First, educators need to recognize and identify that the underrepresentation of girls in CSE courses is a problem, and then there needs to be an effort to make a change. There are proven methods to initiate this change. Different methods may work for different schools and each school will need to experiment to see what brings about the desired result. The sought after outcome may also be different for each school, but any increases in the number of girls in CSE courses is a start in the right direction. The numbers may start small and rise over time, but change must be initiated by educators within the school.

This problem is a concern for other schools as well, including schools throughout New England. The state of New Hampshire (New Hampshire Department of Education [NHDOE], 2006) has identified women as the minority in engineering occupations and referred to women in engineering as a "special population." In response, the NHDOE has created the Pre-Engineering Program, which encourages "more female students into this high-skill, high wage profession" (NHDOE, 2006, p. 10). One of the goals of this program is to change the view of engineering "as an opportunity for students of both genders" (NHDOE, 2006, p. 10). Massachusetts (Massachusetts Department of Education, 2004) considers programs such as science, engineering, and technology as

nontraditional programs for females. Connecticut (Report to the Governor, 2013) found that high school girls are less likely than boys to be interested in science, technology, engineering, and math (STEM) courses. The women who do end up in STEM careers are paid significantly less and have poor retention even though businesses express the desire and value for women in their companies. At the first National Summit on the Advancement of Girls in Math and Science in 2006, U.S. Secretary of Education Margaret Spellings stated "our country cannot afford to lose half of our potential innovators" (p. 1). Spellings also stated that girls make up only 15% of advanced placement computer science courses and less than 20% of college engineering majors, and the number of women with college computer science degrees decreased 25% from 1985 to 2006.

Unfortunately, this problem extends beyond the United States. Australia has between 10% and 30% of girls taking information technology courses, and less than 20% are found in these types of careers while Africa has the lowest rates in the world of girls enrolled in science and technology courses (Miliszewska & Sztendur, 2010). This global problem does not have a quick fix. Schools need to make more of an effort to understand the problem so they can begin to create an atmosphere that encourages equity. Changes may start small within individual districts and spread to other districts, states, and countries to encourage all girls to learn more about CSE courses and careers.

Rationale

Evidence of the Problem at the Local Level

During the 2010-2011 school year, 152 students enrolled in CSE courses at the high school in this study. Only 24 or 16% of these students are girls. Educators within the school have noticed a difference, but there has not been discussion about what to do to change these numbers. Typically, girls who take a CSE course continue taking more from both the computer science and the engineering departments. It is assumed that only the students who are interested in CSE courses are taking them because all courses in these departments are electives and students must sign up for them,. The school has not done anything to increase awareness, build interest, or focus on increasing the number of girls in these courses. Knowing how the educators in the high school feel about the underrepresentation of girls, why they think this inequity exists, and what they feel they can do to encourage more girls to be involved in CSE courses may help in understanding why more has not already been done.

A middle school from a neighboring district has shown interest in trying single gender classes in language arts and math. The idea is that single gender classes may help girls do better in math and boys do better in language arts. This strategy could translate into increased enrollment in CSE courses if girls are more confident in math and problem solving. This school has been attempting to start these single gender classes for 3 years. They want to offer them as optional classes for students whose parents are interested. Parent support is needed because students in the middle school are not allowed to choose their classes. The school would need a class of about 15 to 20 girls and 15 to 20 boys.

Every year, several times a year, the math teacher holds information nights to inform parents. Usually only two or three parents show up. Although the teacher has data to support why he believes this type of class will improve the district's scores on standardized tests, there is a lack of interest among students and parents. If more parents backed this initiative, then the school could try one class of boys and one class of girls to see how it would impact confidence and success in these classes. Greater self-confidence from girls in middle school math is expected to promote greater achievement, which can then create more interest in CSE courses as they enter high school and college. This middle school does not offer CSE courses, so their primary focus is on math scores. However, if they were successful, a secondary impact could be seen in high school math and CSE courses. This school is an example of educators trying to make a difference, but only trying one method that is not working for them.

Locally there have been efforts made to increase interest and expand participation in CSE courses; however, these efforts are not specifically targeting girls. A technical high school in the area accepts students from various districts and offers programs such as pre engineering and computer programming. Once a month they have a night of technology during which middle school students from participating districts can learn about computer programming to build interest in the CSE program. In a session of about 40 students, on average only one or two girls attend each month. These indirect efforts by area schools have not resulted in an increase of girls in CSE courses. As the community, including students, parents, and educators, gain more of an understanding about what CSE involve, they may begin to see a change in the number of girls

participating. There are ways schools can start this trend, but it will require education and a clear comprehension of the goal.

Evidence of the Problem From the Professional Literature

The percentage of high school girls interested in studying computer science in college dropped from 37% to 20% from 1991 to 2001 (Agosto, 2007). This trend transfers to the related workforce as well, leaving the country with a shortage of qualified professionals and less diverse ideas (Papastergiou, 2008). If more girls can be encouraged to take CSE courses, then more women can fill these positions and bring new insights to the field. While women receive more than half of all bachelor degrees and make up virtually half of all workers, only 25% major in computer science, 21% major in engineering, and 26% are employed in science and engineering fields (Halpern, Aronson, Reimer, Simpkins, & Wentzel, 2007). Although women show higher levels of self-motivation, persistence, and responsibility (Lau & Yuen, 2010), women in leadership positions in the technology profession are outnumbered six to one by men (McKinney, Wilson, Brooks, O'Leary-Kelly, & Hardgrave, 2008). This vast difference is the result of the underrepresentation of women throughout the entire process. This process begins in school just by being exposed to what CSE courses are. The progression then continues with girls having more interest and confidence with these courses, which leads to choosing CSE as a college major. The advancement concludes with women in the CSE fields, who then can be promoted to leadership positions. Without the initial increase of female students at the school level, none of the other accomplishments can happen.

There is an increasing demand for computer related occupations yet women make up less and less of this population of workers. The U.S. Department of Labor predicted engineering and technology jobs are growing at four times the national average (as cited in Shanahan, 2006). Increasing the numbers of students taking these courses is needed to fill these emerging jobs. To make this workforce more diverse and equal, increasing the number of girls in this field is needed as well. The goal of education is to get its students ready to become contributing members of society and to give all students equal opportunities. Schools must take on the responsibility of preparing girls to enter CSE careers. Education has let gender stereotypes and misconceptions hinder enrollment numbers for girls in CSE courses. Change must begin in all educational facilities to alter these preconceived notions and misunderstandings. According to Varma and Hahn (2008), there are three things that can "improve representation of women in computing field" (p. 10). They are continued exposure because "their interest in science does not seem intrinsic and instead it evolves over a time period" (p. 10), guiding students based on their specific situations, and letting female students know the value of CSE in their future. Educators need to understand the importance of this responsibility and what they each can do to influence this transformation.

Definitions

AutoCAD: Architectural design software (Woodford, 2002) used in engineering.

C++: A programming language (Beneker, 2003).

Computer science and engineering (CSE) courses: Programming and engineering courses that are math based and problem-solving oriented. According to job descriptions

at the National Institutes of Health (2011), both CSE positions include problem solving and knowledge of mathematical techniques.

Flash: Animation software (Featherly, 2002).

Java: A scripting language developed to process information (Beneker, 2003).

STEM: An acronym for science, technology, engineering, and math (Buzzanell & Lucas, 2006). STEM education integrates these four disciplines and "the processes of inquiry, design, and analysis" (Bybee, 2010, p. 31).

Visual Basic: A high-level, object-oriented programming language (Beneker, 2003).

Significance

This problem is significant to education because CSE courses and careers have been "inhospitable to the representation, advancement, and inclusion of women" (Bilimoria, Joy, & Liang, 2008, p. 424). Bias from inside and outside of schools has contributed to girls not having equality in the classroom, especially when it comes to math, science, and technology. Education should provide a place where students can explore and develop their interests and talents because it may lead to job opportunities and making a living.

Although the demand for qualified and skilled CSE employees increases, there continues to be a shortage of women in these fields (Buzzetto-More, Ukoha, & Rustagi, 2010). Companies are making decisions to offshore work due to several reasons including the lack of qualified personnel. Offshore work increased from 42% in 2004 to 68% in 2006 with information technology and product development, which includes

engineering, accounting for the top two functions being offshored (Manning, Massini, & Lewin, 2008). There is a need for more creative and talented people in these careers. Women in the United States can be included in the pool of potential employees to help keep some of these jobs from going offshore. The country is missing out on the talent of an unknown number of women due to gender gaps in this profession. "This is a grim situation for both the women whose potential remains unutilized and the U.S. society which is dependent on IT" (Varma, 2010, p. 301). Creating an educational environment that provides a gender balance will allow more girls to experience CSE so that they can have a chance to see if this is a career choice for them. Not only does the industry need more women in these careers, we also need them in education. These careers include women CSE teachers, which make good role models for girls and can help with encouragement and self-confidence.

Throndsen and Turmo (2012) stated that educators are important influences in a student's learning and that factors such as how a teacher instructs, the teacher/student relationship, whether the teacher is male or female, and even the teacher's beliefs on gender issues may affect student attitudes and learning. There are many studies that center on instruction, relationships, gender differences, and ways to increase girls' interest in CSE courses, but there is a lack of studies focusing on how educators feel about these issues.

Guiding Questions

What are educators' perspectives on female students' enrollment in CSE courses? What are educators' views about making changes to encourage girls to be more involved with programming and engineering courses?

These questions guide the study to find out if educators within the school understand that there is a problem and that there are specific things that can be done to make improvements. The people who can make changes need to recognize the problem and know what to do before any changes can be made. Teachers can make changes in their classrooms to spark interest in CSE courses. Administrators can make changes to curriculum or policies to make school-wide decisions. Guidance counselors can speak to students to find their interests and encourage CSE courses. With all of these influential people within the school, there are adjustments that can be implemented to determine what makes a difference with girls within this school. Understanding what educators think about female enrollment in these courses will show why changes have not already begun and could encourage change to take place.

Review of Literature

The literature review was primarily conducted using resources from Walden University's online library. Education and CSE research databases were searched for relevant data that provided background information for this study. These references were also chosen predominately within a 5-year time frame. Various searches within ERIC and Computer and Applied Sciences Complete, as well as other databases, were used.

Examples of keywords examined were *STEM*, *computer science and engineering*, *girls and computers, pair programming, single gender courses,* and *CSE*.

History of Women and Programming

Ironically, the first computer programmer was a woman, Ada Lovelace (McCormack, 1998), and the pioneer of software development that inspired programming languages was also a woman, Grace Hopper (Graham, 2011). Without the contributions of these women, the history of computers would be different. Klawe, Whitney, and Simard (2009) stated that in 1985 women received 37% of computer science undergraduate degrees, a percentage that dropped to 22% by 2005. They also indicated that jobs held by women in math and computer science decreased from 33% in 1984 to 27% in 2004. The number of women in these careers does not incrementally go up with the increasing number of jobs in this area. In 2008-2009 women earned 57% of all bachelor's degrees, but only 18% earned these degrees in computer science fields and only 16% in engineering (Aud et al., 2011). The numbers of women in this profession continue to fall even though the demand for computer scientists and computer engineers is expected to rise 37% by 2016 (Meelissen & Drent, 2008). The underrepresentation of women in CSE courses has increasingly been the topic of studies since the early 1990s (Varma, 2010). Klawe et al. (2009) blamed bias and stereotypes as the reasons for these declines. Included in their list of ways to dispel these myths are to provide accurate information, show the social impact CSE jobs can have, and give girls appropriate exposure to technology, including using pair programming. Lastly, the authors stated that positive change relies on the community as a whole allowing computing fields to be

supportive and inclusive. Changing the mindset of students, educators, and professionals of both genders is important to opening the door so that everyone feels welcome and that they can be successful in CSE positions. The following section presents a discussion about how educators affect students' attitudes and what educators can do to change the attitudes about girls' lack of participation in CSE courses.

Gender Characteristics

Both brain research and social theories give insight into why this gender discrepancy exists in CSE courses. Brain research shows that girls and boys think and learn differently. While men and women have similar levels of intelligence, women have stronger verbal ability and emotional intelligence whereas men have stronger visuospatial ability (Jausovec & Jausovec, 2008). Social theories (Else-Quest, Hyde, & Linn, 2010) suggest that gender behaviors are formed from sociocultural factors, which affect self-efficacy. Girls are thought not to be as interested in CSE courses because they are more social than boys and feel as though these courses are socially isolating (Reis & Graham, 2005). This behavior also affects their computer usage. Tsai and Tsai (2010) stated that girls use computers more for socializing and want to know how computers can affect their lives while boys use them more for gaming. These authors also explained that although both girls and boys use the computer to surf the Web, boys explore more whereas girls use it more for communication. Girls respond more to the human element of computer usage while for boys it is more about entertainment.

Girls tend to do better on reading tests while boys tend to do better on math and science tests. Although girls are more likely to go to college, they are underrepresented

in technical fields such as CSE (Dee, 2006). Unfortunately, the United States is not the only country with this gender gap in computer science degrees (Anderson, Lankshear, Timms, & Courtney, 2008) or engineering degrees (Dlodlo & Beyers, 2009). There are many organizations around the world that have programs to promote girls in this area, including the Ada Lovelace Project (Cozza, 2011), which motivates, mentors, and trains girls in science, mathematics, engineering, and technology. They introduce, encourage, and support girls, so there is more interest in technology-related courses and careers. These programs also try to break the stereotype that these are courses and careers for boys.

The President's Council of Advisors on Science and Technology (2010) stated that the United States is behind other nations in STEM education. There is a serious interest and achievement gap among women in these fields. "This gap limits their participation in many well-paid, high-growth professions and deprives the Nation of the full benefit of their talents and perspectives" (p. vi). This executive report sums up the importance of the issue:

> The success of the United States in the 21st century—its wealth and welfare—will depend on the ideas and skills of its population . . . STEM education will determine whether the United States will remain a leader among nations . . . It will help produce the capable and flexible workforce needed to compete in a global marketplace. It will ensure our society continues to make fundamental discoveries . . . It will generate the scientists, technologists, engineers, and mathematicians who will create the new ideas, new products, and entirely new

> industries of the 21st century. It will provide the technical skills and quantitative literacy needed for individuals to earn livable wages and make better decisions for themselves, their families, and their communities. And it will strengthen our democracy by preparing all citizens to make informed choices in an increasingly technological world. (p. v)

This report to the President specifically states that the problem lies in the lack of interest in this area, and the nation must work on preparing and inspiring all students to learn STEM subjects. Recommendations include developing standards, training and recognizing teachers, improving educational technology, creating opportunities for students, and creating STEM-focused schools.

McKinney et al. (2008) discovered that most of the reasons for entering this field of work are the same for men and women. The one exception was that significantly more men chose this career for the love of computers and technology. Women did not feel as strongly about computers and technology. Experience and attitudes also were similar for both genders, but women answered that they were not as comfortable or confident with technical language and skills. Women do not have a lack of ability; they just do not have the same self-confidence as men in this area.

Girls' perception of CSE courses are that they are boring (Anderson et al., 2008), even though online communication is dominated by women. Collaboration and networking are strengths of women. Women want to know how technology can affect their lives (Crocco, Cramer, & Meier, 2008). Girls are more social and think courses and jobs in CSE are socially isolating (Werner & Denner, 2009). Girls find greater peer

relationships with others through communication such as social networking and blogs. Boys have greater peer relationships by sharing experiences such as games with them. Computers are often thought of as socially isolating, but online use for both boys and girls is a valuable tool for relationships (Desjarlais & Willoughby, 2010). Suggestions based on a study conducted by Kulturel-Konak, D'Allegro, and Dickinson (2011) were to use real-life examples or create internships and create an environment that is collaborative. When using computers for personal use, boys and girls utilize them differently.

Lau and Yuen (2010) from the University of Hong Kong found that gender differences affect learning styles. Girls are more concrete sequential and abstract random learners. Concrete sequential learners use their "physical senses" and "think in an orderly, logical, and sequential manner" (p. 1094). Abstract random learners "have a strong sense . . . of feeling and emotion" and "think in a non-linear and emotional manner" (p. 1094). Boys are more concrete random learners, which tend to "like to experiment with ideas and concepts and think intuitively, instinctively, impulsively, and independently" (p. 1094). Girls are also influenced more than boys by parent and teacher motivation. Teachers can vary the way they present material and individualize instruction to appeal to more students. Gender sensitive and female friendly computer science classrooms have environments that engage more girls.

Single Gender Classes

One way educators can help girls be more successful in CSE courses is through single gender classes. Academic performance has seen an increase while discipline

problems have seen a decrease in single gender classrooms. The goal in education is to meet the needs of every child (Rex & Chadwell, 2009). Each class can be designed to meet the interests and strengths of each gender. Not only do girls perform better in single gender classrooms but they also have a better attitude toward technology (Miliszewska & Sztendur, 2010). According to McKellar, (2007) girls need to relate math and problem solving to things that are relevant to them to understand it better. Single gender courses allow for this personalization to happen.

Miliszewska and Sztendur (2010) conducted a study in Australia and found that at coeducational schools most girls between the seventh and twelfth grades use computers to do such things like word processing (80%) and surf the Web (56%). Significantly fewer girls use computers for more advanced computer skills such as programming (15%). However, at all-girl schools the number of girls using basic computer skills drops while the number using more advanced features rise. Seventy-four percent use word processing, 48% surf the Web, and 22% program. These percentages are slight differences but do show that single gender classes are a viable option to help close the gap.

Girls in single gender classes have been reported to feel that they have more "teacher support, computer-related confidence, and academic intentions" (Varma, 2010, p. 303) in CSE courses than coeducational classes. "Due to insufficient training and unequal emphasis to male and female students" (p. 302) teachers may unintentionally affect attitudes.

Pair Programming

Another way educators can help girls in CSE courses and change the typical perception of the CSE field is by using pair programming in the classroom. Pair programming is another way to structure CSE courses so girls will find more interest in them and be more successful. The idea is to work with a partner, so there is more interaction and collaboration. Girls tend to respond better working with a partner and are more willing to enroll in courses that involve pair programming (Werner & Denner, 2009). Middle school girls were found to work together to problem solve and debug programs (Denner & Werner, 2007). This type of cooperative problem solving helps them to work through more complex predicaments in a way that makes them feel more comfortable. Girls are considered more social than boys and need to talk things through. They can discuss and collaborate on ways to solve problems rather than just individually work on tasks (Rex & Chadwell, 2009). It allows the pair of students to take turns learning by doing and learning by teaching (Han, Lee, & Lee, 2010). Pair programming is one strategy teachers could use in their classrooms to make CSE courses more appealing to girls.

One misconception girls have is that programming and engineering are socially isolating when, in fact, the opposite is true in industry. Collaboration is important for computer programmers and engineers to work together, understand each other's work, and create work that each other can easily understand. The United States and other countries have created competencies in engineering education that include the "ability to work in multidisciplinary teams" and "communication skills" (Goel & Kathuria, 2010, p.

184). Pair programming helps these types of educational courses to meet the needs of these competencies as well as help all students in their design and problem solving skills. Teachers who use pair programming are helping to change the CSE stereotype.

Role Models

Role models within the school, particularly from women, are an important way educators may help encourage girls to take more CSE courses. According to Vekiri (2010) boys' interests and the importance of CSE courses relied more on their parents' support while teacher expectation are important to girls. Student centered teaching was important to boys' interest and importance. For girls, student centered teaching improves their interest in CSE but it does not affect their perception of the importance of these courses. Changing how girls view the usefulness and importance of these courses is needed to change stereotypes and misconceptions about these courses and careers. Instructional intervention is needed to make this change.

Thirty-one percent of full time science, technology, engineering, and math (STEM) faculty consist of women and only 27% of women make up administrative STEM positions such as deans and department heads (Gorman, Durmowicz, Roskes, & Slattery, 2010). When separating out just engineering faculty, women represent only 9.5% (O'Shea, Heilbronner, & Reis, 2010). There is no reason that this percentage should not be equivalent with the number of men in these same positions. Stevenson University in Maryland, on the other hand, boasts that 71% of their STEM faculty and 100% of their STEM leadership positions are women. They have also increased their STEM enrollment to 29% of majors, which makes it the biggest division in the school.

Credit is given to their all women mentoring program. There is mentoring for leadership positions, faculty and students. Feminine role-models, as well as their leadership style of open communication, are believed to "encourage, enable, and empower more women to engage and be successful in STEM disciplines" (p. 11). If a woman teacher is a confident computer user, she will have more of a positive influence on girls' attitudes towards computers (Meelissen & Drent, 2008).

The role model theory states that having a female teacher teach these courses helps girls to think more positively about these courses (Meelissen & Drent, 2008). Unfortunately, teachers are not immune to this gender gap. Without many role models, change must start somewhere and work its way through the cycle of students, teachers, and workers in the profession. Educators, especially women educators, must recognize their potential as role models for girls. This role is particularly important for educators involved in CSE courses where change and role models are needed.

Recommendations for Change

There are several actions that schools can take to encourage increased female enrollment in CSE courses, starting with exposure. One way to introduce all students to CSE is to have short, gender neutral activities in other courses like English, math, or science. Gender neutral examples can simply be relating what is being taught to activities that both girls and boys may identify with and not continuously use topics such as sports or fashion that would favor one group. Exposing all students to this neutrality may encourage more boys and girls to pursue these types of courses and careers (Carbonaro, Szafron, Cutumisu, & Schaeffer, 2010). This example is one way to change

people's perception of what the courses are about. Without any experience or knowledge of this area of study, students may have the wrong ideas about how difficult or boring it is.

The Institute of Educational Sciences (IES) gives the following five recommendations as advice for teachers to address this issue and begin to close this gap: teach students that academic abilities are expandable and improvable; provide prescriptive, informational feedback; expose girls and young women to female role models who have succeeded in math and science; create a classroom environment that sparks initial curiosity and fosters long-term interest in math and science; and provide spatial skills training (as cited in Halpern et al., 2007, p. 9).

Similarly, Papastergiou (2008) conducted a study in Greece and found a few of the same answers to be effective. The proposed actions from this study are ways the educational system may help change girls' perceptions and increase their interest and self-confidence in this area. Exposure at the high school level to understand better what CSE is about would help demystify these courses and career choices. Changing curriculum and materials to include activities that emphasize the social aspects of computing would allow girls to see that it is not socially isolating and does have a human element to it. Highlighting women in the field through guest speakers, mentors, and outreach programs would help break the stereotype that these courses and careers are only for men. The important piece to all of these suggestions is that they are all done within the school. Teachers, administrators, and guidance counselors would be responsible for making these changes and modify the direction of this trend.

A high school in Virginia has a model technology program and has increased enrollment, including women, in their engineering program. One girl interviewed stated that she was hesitant to take these courses because she is a girl but once she experienced it, she felt like it was a perfect fit for her (Alukonis & Settar, 2008). Having a hands-on learning style, teachers who facilitate a student-centered learning environment and state-of-the-art technology and equipment all contribute to students' interest in these courses. These pieces work together to encourage all students to learn and continue in this area of study.

Parents, teachers, and administrators must find ways to encourage girls to take CSE courses. In order for the United States to be a leader in technology, we need to have as many students as possible interested in these areas (Milo, 2010). Teaching educators how to promote and foster excitement in CSE and then support girls along the way will not only increase enrollments and career choices but also help in many other immeasurable ways.

According to Cheryan and Plaut, (2010) people join groups that they feel most similar to. They also stated that perceived similarity translates to interest and "women felt less similar to computer science majors than men, and this lack of perceived similarity accounted for why they were less interested in pursuing the field" (p. 480). Without a sense of belonging, they feel that they cannot relate to the people in that group. Suggestions coming from this research are to change how girls see themselves. If they perceive themselves as technically inclined then they would identify themselves with CSE courses/fields and will show more interest.

Educators are not immune to gender bias and perceptions. According to Varma (2010) before students reach high school, the perception is that math, science, and computer-related courses/fields are for boys. When a teacher's perception is lower in girls, the girls show more anxiety and less confidence. With teacher training and female role models, it is believed that these perceptions can change. The findings from Varma's study mentioned reasons such as lack of role models, limited or no exposure to these courses in school, and the perception of restricted social relations in these fields. Participants specifically point to schools not encouraging girls as a reason there are so few girls in CSE courses/fields. Suggestions coming from this study are that teachers need to improve their teaching style to change their own and their students' mindset. Teachers need to view, expose, and motivate all students equally.

Buzzetto-More, Ukoha, and Rustagi (2010) found that participants suggested "greater academic support would increase the enrollment, success, and retention of underrepresented students" (p. 115) in CSE courses. Again schools were blamed for not exposing students to CSE courses, not providing career counseling, lack of role models, and having low expectations that diminish confidence and success.

Responsibility of Educators

All of the previous data point to changes being made within the school. Changes by educators are the first steps in increasing the amount of girls interested in initially taking CSE courses and eventually working in the field. There are several ways to make this change that will begin the transformation. Characteristics, such as gender stereotypes and bias, affect self-confidence, which in turn decreases success and interest. Educators'

conscious efforts toward gender equality may expand initial participation and continue with increased attraction. Female role models help girls relate to and perhaps perceive themselves as computer programmers and engineers. Required exposure for all students may grow awareness and dispel misconceptions about what CSE is. Gender neutral activities, single gender classes, and pair programming are all ways to change girls' perception of what they believe CSE courses/fields to be and how they fit into them. Different methods may work better for some schools than others but schools need first to be aware that there is a problem and then be aware what strategies should be implemented.

Implications

By understanding educators' perspectives on the shortage of girls in computer science, administrators and guidance counselors may see the lack of interest from the female population, but not realize that there are possible solutions to this problem. STEM teachers can structure or promote their courses in such a way that may prompt more girls to enroll in them. Administrators can restructure curriculum in creative ways to encourage girls to sign up for CSE courses. Guidance counselors can talk to students to explain what CSE courses are about and what kinds of job opportunities they can offer. If the girls within the school know that teachers, administrators, and guidance counselors are pushing for them to experience what these courses have to offer, more may make an effort at least to see what they are all about.

The project direction that arose from the data received included creation of professional development training for all STEM teachers, administrators, and guidance

counselors (Appendix A). This training could result in experimental strategies to see what impact change can have at this school. Another direction that this project may take is that this school can become a role model to others about increasing the number of girls in CSE.

Social change can occur as schools from all over the world and from any grade level, including higher education, can benefit from the findings of this research. Understanding how educators view this problem is the first step in restructuring CSE courses and ideas to inspire girls to partake in various programming and engineering courses, which then impacts industry as more talent expands innovation.

Summary

Twenty-first century skills rely heavily on science, technology, engineering, and math (STEM) curriculum. Technology is increasingly used and relied upon in today's society. To have true equality, inclusion, and diversity in the classroom, girls must also be involved in this increasingly important field and not be left behind. This involvement will not only benefit the girls who take these courses, but it will also benefit colleges by increasing their enrollments in these majors and the industry as a whole with more people from which to draw ideas.

This problem section describes how the underrepresentation of girls in CSE courses is a widespread and researched problem. There are various reasons why girls do not take these courses based on how they view and believe these courses are as well as the difference between girls' and boys' interests. Change must start in our school system to educate and change stereotypes. We need to understand how teachers, administrators,

and guidance counselors feel about the lack of girls in all CSE courses, if they realize the importance of this underrepresentation of girls, and if they are willing to make changes. These influential people need to recognize their role in moving forward.

The methodology section presents how the research for this project was conducted. It gives details regarding the research design as well as the approach used. Participants are described. How data were collected and analyzed are detailed. Ethical issues such as permissions and consent are clarified. Qualitative results are also explained. The process, data analysis, outcomes, and evidence of quality are examined.

In Section 3, the proposed project is discussed and consists of a description of the project, its goals, and rationale. The review of literature section addresses key research on professional development because the project consists of training for educators. Implementation of the project is also discussed including resources, supports, barriers, and roles and responsibilities are also discussed. The evaluation plan is stated with its outcomes and performance measures. Local and far reaching social change implications are identified as well. Lastly, Section 4 is a discussion of personal reflections, including analysis of scholarship, project development, evaluation, leadership, and change.

Section 2: The Methodology

The methodology used provided the data needed to answer the guiding questions. This qualitative case study included interviewing CSE teachers, administrators, and guidance counselors. Participants were interviewed and then participated in a focus group. Tape recorded audio files from these one-on-one interviews and the focus group were analyzed and coded to find themes within the responses.

Research Design and Approach

A qualitative case study design was used to understand what educators' perspectives are on female students' enrollment in CSE courses. Specifically, in this study I looked at the problem of education not doing enough to encourage more girls to participate in CSE courses. In particular, I asked questions about educators' perspectives on female enrollment and how these educators believe they personally can do something to bring about change and encourage more girls to become interested in these fields. Gaining an understanding to the answers of these questions provides a guideline for this and other educational institutions to focus on how education can do more to inspire girls to pursue CSE education.

Description of Research Design

An instrumental case study research design allows for data to be gathered to understand a question or problem for greater insight into the issue (Hancock & Algozzine, 2006). Case studies are also unique in that they focus on bounded systems

(Merriam, 2009). This type of design approach was best for this study because it focused on a small group in a particular setting that comprises educators in one school. Data provided insights into the thoughts of the people who have influence in making changes to CSE courses within the school. Many studies have been done to determine why girls do not sign up for CSE courses as much as boys, but studying how educators feel about this difference is unique. Participants were able to bring understanding from an educator's point of view. The study was bounded by CSE courses in the high school. The number of students involved in these courses at a particular time and the number of educators who could be interviewed are limited.

In order to understand why girls are underrepresented in CSE courses, it is important to understand what educators' perspectives are on this matter and if they recognize what can be done to effect change. A case study allowed for interviews and a focus group to be conducted to find out what teachers, administrators, and guidance counselors in this school think causes the gender difference in the CSE courses and what ideas they have to make changes. It also allowed the participants to express if they have tried to make changes and what results, if any, they have found. Because literature shows there are specific things that can be done to increase the number of girls in CSE courses, this study was designed to provide insight into how educators accept, resist, or are even aware of these changes. These three categories of educators (teachers, administrators, and guidance counselors) all have various roles in making changes in this particular area, and they can potentially make real change happen.

Justification of Research Design

Because this study was designed to find the perspectives of its participants, quantitative research would not have been appropriate. Collecting data through a questionnaire would not have allowed me to understand the participants' feelings. Quantitative research summarizes its results numerically using statistics. Statistics would not have been able to show how participants feel about an issue as well as a narrative could.

Other qualitative research designs are less effective choices due to the nature of this study. Ethnographic studies focus more on cultural groups and concentrate on a particular setting (Lodico, Spaulding, & Voegtle, 2010). This study focuses on a problem that is worldwide and not restricted to only certain cultural groups or settings. Grounded theory research uses the data gathered to find a theory (Lodico et al., 2010). This study is not developing a theory, but rather understanding how education can make contributions to increase women in CSE. The conclusion is that a case study is the best design for this study.

Participants

The setting was at a high school that includes students from four towns in a suburb in New England. About 1,500 students attend this school. One hundred and six teachers work at the school full time. The greater population includes all the teachers in the high school.

Justification for the Number of Participants

Purposeful sampling was used because it only includes participants involved with CSE, such as the computer science/engineering teachers, administrators, and guidance counselors. The sample included these three types of educators because they have knowledge of some aspect of the CSE courses in the school. Interviewing people who are different types of educators with separate roles allowed for adequate depth of inquiry. Their thoughts and opinions are important because they are the ones who determine if and how courses are run and were able to comment on information regarding these courses. Educators who have no direct involvement with CSE courses were not asked to participate in the study because they do not have insight into the issue and would not be able to take the lead in any possible changes that may happen. At the time of the study, possible participants at the school included one computer science teacher, one engineering teacher, one principal, one associate principal, three assistant principals, eight guidance counselors, and one STEM curriculum coordinator. The sample size included all of these 16 people.

Procedures for Gaining Access to Participants

The high school principal approved the necessary permission to conduct the interviews. Walden University's Institutional Review Board (IRB) also granted approval before proceeding with data collection. Each person in the sample was sent an Invitation Letter (Appendix B) explaining what the study was about and inviting them to participate. One-on-one, face-to-face interviews were conducted in any available office or classroom at the time. E-mail interviews were offered if scheduling a time to meet

was an issue and might have been a factor jeopardizing participation in the study. No e-mail interviews were conducted. After all interviews were over and participants had time to reflect, a focus group was scheduled. This focus group allowed participants to speak to one another about their ideas.

Methods of Establishing a Researcher-Participant Working Relationship

Pre-interview preparations and discussions established a proper working relationship between the participants and me. That process began with informing educators asked to participate as to the purpose of the study. The participants were also informed that they could stop the process at any time and withdraw from participating for any reason. Whether they chose to participate, not participate, or drop out of the process, there would be no repercussions from their decision. Participants were informed that their responses would be kept confidential and would not affect their working environments or relationships.

Measures for Ethical Protection of Participants

The participants in this study are all adults who work in the school. In order to protect participants from unethical treatment, the Informed Consent Form (Appendix C) was read and signed. This form stated that participants willingly volunteer in this study and that they may choose to decline or end their participation at any time without penalty. The form explained the purpose of the study as well as the procedures for conducting the interviews. The consent form also affirmed that Walden IRB reviewed and approved the study and gave contact information should participants want more information. Participants were encouraged to answer honestly for research purposes and reminded that

their answers were confidential and anonymous and would not change any relationships or work-related affairs. No participant or student, if mentioned, was referred to by name. There was no discussion with anyone in or outside of the study regarding responses. Data collected and documents were kept out of view. Confidentiality is important for the integrity of the study.

Data Collection

Each potential interviewee was contacted in person or by e-mail to explain the nature of the study and ask if they would be interested in participating. The Interview Protocol Form (Appendix D) was used as a guide to ask questions and begin discussions.

Questions formed were designed to answer the study's guiding questions about educators' perspectives on female students in CSE courses and how they think courses, teaching strategies, and curriculum changes could encourage more girls to be involved in these courses. There was flexibility with follow up questions asked based on responses and discussion from open-ended questions. The focus group allowed for further discussion among participants.

Data were gathered using semistructured face-to-face interviews. If a participant could not meet face-to-face due to time constraints, the individual was offered the option to conduct the interview via e-mail to accommodate because inclusion of as many participants as possible is of great importance. There were no e-mail interviews conducted. Types of questions included questions of knowledge about the underrepresentation of girls in CSE courses, experience questions regarding what they have observed or done with students in CSE courses, and opinion questions to see how

they feel about making changes in what they do to encourage more girls to take CSE courses. These questions were appropriate for a qualitative study because they are open-ended. Several days after all interviews were completed, the focus group was scheduled, and participants were invited. Time in this group allowed for open discussion between the educators regarding their ideas.

Ideally, all of the sample would have been included in the interviews, which consisted of 16 educators in various roles throughout the school. In reality, there were only seven participants who were interviewed. A couple of people expressed that they would like to participate but did not feel that they knew anything about the topic. These people included an administrator who was more involved with humanities. E-mail interviews were offered in case someone felt they did not have time to meet face-to-face. No one conducted the interview this way. Each face-to-face interview was scheduled for 30 minutes, but some took more time and some took less depending on the participant.

The focus group was scheduled after school for an hour. The Focus Group Protocol Form (Appendix E) was followed to remind participants why they were there, what they were there to talk over, and start the discussion. Six people participated in the focus group. It was a great opportunity for participants to discuss problems and solutions with each other. The open communication was important so that each educator could see the other educators' point of view and begin to understand how the school as a whole can come together and make changes.

Data were collected during interviews and a focus group, which were scheduled before or after school because that is the best time when we would less likely be

interrupted. These interviews and focus group were held in an available office or classroom. The interviews and focus group were tape recorded. Reflective journals were used after each to record my thoughts about the main points that came out of the interviews.

Data were generated beginning with questions shown in Appendix D. As discussions emerged, follow up questions expanded upon and clarified any uncertainties. All interviews were recorded using an audio tape recorder, which ensured accurate preservation of data for analysis (Merriam, 2009). The focus group allowed participants to discuss their thoughts and ideas with each other. This discussion was also tape recorded.

Reflective journals allowed for initial thoughts to be written down after each interview. Member checking assisted with reliability, credibility and validity. Participants were emailed the transcript of their interview and looked for any inaccuracies. Themes in the data were found from reviewing interview recordings, transcripts of interviews, and reflective journals.

Potential participants were contacted either in person or by e-mail. When these people were asked to participate, they were told what the study is about and how their participation would be valuable. If they chose to participate, they signed the Informed Consent Form (Appendix C) and the meeting time and place was scheduled.

Role of Researcher

I am a technology teacher at the high school and have been employed there for 4 years. The CSE teachers are coworkers with nearby classrooms. There is no previous

relationship with them as they are both new to the school this year. The principal, associate principal, assistant principals, and STEM coordinator all have a supervisory role to me, and one is my primary evaluator. I have a good professional relationship with all the members of the guidance department. These relationships did not affect data collection. I did not allow my opinions, experiences, or biases to be known during data collection. Instead, I focused on the factual responses from participants during the interviews and did not give any indication as to my thoughts.

Data Analysis

How and When Data Were Analyzed

After all interviews and the focus group were completed data analysis took place. Transcriptions from each recorded interview, focus group, and reflective journals were analyzed for differences and similarities between the participants. Data were organized topically and analyzed by hand. Responses were sorted and divided by questions and the three main groups of educators (teachers, administrators, and guidance counselors). Patterns were explored within and between these groups. Member checking was used to make sure data were worded correctly and were unbiased.

Accuracy and Credibility

Coding was used to search for recurring words and ideas for thematic analysis. Themes and relationships among and between the three groups of educators were also analyzed for any commonalities. It was important to supply as much information as possible to explain the findings because qualitative analysis is more of an interpretation of the data. Rich, thick description is detailed and includes dialogue and quotes from

participants, which provided credibility to the analysis. Triangulation using multiple sources of data was also used. Interviewing various types of educators gave the data different perspectives to compare.

Discrepant Cases

Discrepant data that did not fit any theme were analyzed and recorded. Discrepancies were not forced into a category. Instead, they were allowed to remain independent and distinct to show their unique perspectives.

Qualitative Results

Process

Data were generated from conducting face-to-face interviews initially and then a follow-up focus group. The following is a sample of some of the questions: Do you think there is anything that can be done to increase the number of girls in CSE courses? Do you think there is anything that you personally can do to increase the number of girls in CSE courses? What types of changes could be made at the teacher, guidance counselor, and administrative level to increase girls' interest in CSE courses? The full list of questions is in Appendix D.

Data Analyses

Data were gathered, and each interview, as well as the focus group, was tape recorded. These recordings were then transcribed. Member checking was used to be sure the transcriptions were accurate. If clarifications were required, changes were made to the transcript, and member checking was done again to make sure it was acceptable to the participant. Transcriptions were reviewed and separated by question and educator

(teacher, guidance, and administrator). Differences, similarities, and patterns were found within and between each group. Themes included identification of a problem, willingness to make changes, and lack of confidence to make changes alone. Educators from each group understood that the underrepresentation of girls in CSE was a problem and had thought about it before. All were willing to work together to make improvements but were unsure how to make this change on their own.

The problem of the underrepresentation of girls in CSE was clear based on educators' responses to the questions given. Not all participants, but at least one educator within each category of teachers, administrators, and guidance counselors, recognized the underrepresentation as a problem in their school and society.

As shown by Table 1, there was a balance of men and women participants as well as previous STEM experience. There was a wide range of years of experience in education and years working at this particular school. Regardless of gender, years of experience, and previous STEM experience, most participants have previously thought about the underrepresentation of girls in CSE.

Table 1

Each Participant Initial Data Collected

Educator	Gender	Years in education	Years at this school	Previous STEM experience	Thought of the under-representation of girls in CSE
Teacher 1	Female	10	2	Yes	Yes
Teacher 2	Male	2	2	Yes	Yes
Administrator 1	Female	24	7	No	Yes
Administrator 2	Male	8	1	Yes	Yes
Administrator 3	Male	38	27	No	No
Administrator 4	Male	13	13	Yes	Yes
Guidance 1	Female	6	3	No	Yes

Some participants knew there was a shortage of women in these careers, and others assumed there was. Some made connections with their own college experience, others with what they have seen themselves in the industry (either working or observing). There was no real difference based on what type of educator they were.

One woman participant who was in software engineering before becoming a teacher stated "many women who go into software engineering don't stay." A male participant stated "it's always been that male dominated career." Another participant spoke of an advisory board the school has with Project Lead the Way, which is a pre-engineering program. The advisory board partners with local business and manufacturing facilities. During a visit to a local engineering firm, this participant noticed all the workers he saw there were women. When he asked why, the shop manager said it was just a coincidence which workers were on this particular shift. He also stated that he

believed his female workers produced better work than his male workers. This conversation made the participant question, "Why aren't there more females in it?"

Teachers

Both teachers interviewed have tried to sell their courses to all students. They were looking to increase interest and overall numbers in their classes. Although they have thought about the underrepresentation of girls, they have not done anything specifically to target girls. Ideas are discussed as to what can be done to increase the number of girls in CSE courses, but the teachers still feel powerless to enable this change.

Recommendations are important in recruiting students into CSE courses. One teacher believed that students who come to her class through math recommendations are more interested and serious than students who come from guidance recommendations. Students who are recommended from their math teacher do well in math and already show a competence that will make them successful in computer science.

Marketing and word of mouth are other necessary steps in bringing students to CSE courses. Teachers must sell their courses to students who may not know much about them. Word must get out to the general student population in order to increase numbers of students, including girls, to these courses. The teachers also felt that they could personally increase the number of girls in these classes by forming better relationships to bring students in and then these relationships would also help for retention. One teacher stated the following: "It's much more difficult for me if I don't know them or see them in my classroom . . . I try to be very approachable and very supportive." If students like a class, they are more likely to tell their friends about it. If

that particular student is a girl, she can stress the reasons why she likes that class and make it appealing to other girls, which would help with student word of mouth recommendations.

A vital action in making the biggest changes of all would be to change the mindset of what people think CSE is. The male teacher would like to see single gender classes, but both teachers spoke of choosing projects and books that are more appealing to girls. Less gender-based curriculum with open-ended projects that are not gender biased would be more interesting to girls. One teacher stated,

> You hear "engineering" and people automatically think big machines, robots, cars, trains. Big stuff like factories. They don't think of toys or make up with organic chemistry, chemical engineers and the stuff that's not going to be geared towards factory. It can be anything.

Both teachers agree that changing the mindset is important but neither know how to make this change.

Role models were also recognized as being significant to seeing an increase in the number of girls in CSE courses. The female teacher thought that using her own industry experience could inspire girls to become more interested. She could be a role model for girls who are interested in computer science especially if they know that her background includes being a software engineer.

Both teachers suspect that other educators in the building could help them increase the number of girls in their classes. They felt that the guidance department needs more information about their classes. That way they can talk more specifically

about them to help recruit students. One teacher pointed out "from their [guidance counselors'] view my courses are very similar."

Participants also felt that administration needs to be supportive of what teachers are trying to do in the classroom. Administrators can recommend students they come across who are not challenged enough, who may be a good fit in a CSE class, or ones who do not fit in a regular classroom. CSE classes tend to be a little different than a traditional class in that there is not as much lecture time, but there is more hands-on time. This type of class may appeal to a certain type of student who an administrator can identify. One teacher identified the type of student who would be good for CSE courses as the following,

> There are so many different ways of working in the computer industry. It takes so many different personalities. It takes the precise kids for financial applications and operating system development. It takes the brave, throw everybody aside, leap into it for prototype development. You've got extroverts, introverts, careless and just get it done and bull your way through it, and then you've got the careful, plan through and there is space for everybody in the industry. You just have to find the fit that matches your personality, and that's where you would be the most successful.

When administrators see the various types of students, they can recommend the type of course and even career that they feel is suited for each student.

Another suggestion teachers had is that they would like administrators to market their courses to the community, including other schools in the district that could relay

information to younger students who will be coming to the high school. It also includes taxpayers who would need to approve additional spending for additional equipment, space, and staffing for the growing program. Administrators have more contact and communication with the community than teachers do. They can help sell the courses, raise awareness about what they are, and prepare students for career paths.

Teachers felt that a benefit of having more girls in CSE classes would be that it would eliminate the awkwardness of being the only girl or one of a few in these classes. Problems in the classroom may include seating only one girl, partnering her up, and just overall making her feel comfortable in their class. A barrier that the teachers mentioned is how to change the mindset of what CSE courses are about. One teacher described why they feel students take CSE courses in the following way,

> They [boys] think of it in terms of the mechanical things, that's why they [boys] want to come and check it out… The girls who get into it usually are already interested, and they have their mind set that that is where they are going in college or at least through high school, so they stay with our program more.

Both teachers reiterated that they do not believe they have any real solutions to this problem.

Guidance Counselors

It was reported that guidance counselors already talk to all the top ranking math and science students regarding CSE options. However, there is nothing specifically targeting girls. Freshmen are recommended classes from their eighth grade teachers at the middle school. For the sophomore year, all students meet with their guidance

counselor at the high school to go over their options in high school. This meeting is when the guidance department gets to know the students, including their interests and strengths. Although guidance speaks specifically to students (girls and boys) in high level math and science classes about CSE courses, what they find is that these students usually have such a busy schedule, they do not have time in their schedules for these electives. Students in advanced math and science classes usually are in other advanced classes and trying to take as many college requirements as possible and do not have time to try other classes. As she pointed out, "It would have to be within their four year plan."

The guidance counselor interviewed had some ideas about how to increase the number of girls in CSE courses. Introducing CSE courses in the middle school would help introduce what CSE is to virtually all students because almost all students must take technology courses in middle school. This introduction would help create an early interest and allow students to try these courses before their busy high school schedule. Exposure is important because when students come to guidance and ask what it is about, counselors can only talk about it and show them the description in the program of studies. If they already knew something about it or if they could show students something, it may help them to understand what it is. The guidance counselor expressed, "It's the depth of knowledge I have about the course is going to persuade a kid into taking the class or not." The program of studies is great describing courses on an adult level, but it is not as helpful to students. Wording could change to target the audience. Also, teachers could provide more information to the guidance department regarding their classes. Possible examples could be syllabi, sample projects, a video showing students engaged in

activities, as well as anything else that may demonstrate what each course does. These examples could be shown to students in guidance or advisories. This knowledge would be helpful to guidance in all classes, not just CSE courses.

According to the guidance counselor, another way to increase girls' interest in CSE courses is to have math and science teachers raise awareness of careers that are available in CSE. Teachers showing students that CSE courses prepare for many types of jobs in these fields will help to eliminate the stereotype of what CSE is. The counselor believes that if teachers can show that these courses will matter in the future for these students, it will make a difference. A career day sponsored by the guidance department was another idea that guidance believes will make students more aware of careers in CSE. The guidance counselor would like administration to support what they try to do including awareness events, such as these career days. She also thinks administration can help with creating flexible schedules such as the availability of night school options to deal with the time issue in students' schedules. Flexible schedules would allow students to try other courses at night or take required classes at night to free up more time during the school day to take other classes.

During the interview, the guidance counselor could not think of any barriers or benefits that having more girls in CSE might create. However, she believes the problem of underrepresentation is a national issue. Schools have CSE courses but girls are not utilizing them because of stereotypes and they are not fully aware of all the types of engineering jobs there are. She states that the school has an equal number of boys and girls taking math and science classes but not in the area of specific CSE classes.

Administrators

More than one administrator shared information about a former STEM coordinator. This was a woman who worked at the school about 6 years ago. She tried a "Women in Engineering" program that targeted gifted and talented students in math, science, and engineering. It involved a partnership with industry and she took many students on field trips. A couple of administrators described this program in the following ways: "I don't know if that was an initiative or a one-time shot." "That was really exciting when she started that here. When she left, it fell by the wayside." Unfortunately, there was no recorded increase in girls in the engineering classes during her employment or after she left in spite of her efforts. Another administrator had experienced career days at his former school and stated,

> One of the things our guidance department would strive for was to get male and female representation especially in male dominated professions such as engineering . . . It was a conscious decision to go get female engineers to come in and speak.

Having a career day is something that guidance would like to see happen, as well as administration.

Several administrators mentioned female role models as one way to increase the number of girls in CSE courses. These role models can include teachers, having a career day with people from the field, including graduates of the school, and even just highlighting role models in society. They also mentioned having guidance reach out to students who are good in math and science to encourage them to try a CSE courses. The

underrepresentation of girls in CSE courses was also mentioned as a societal problem that needs to be addressed. One administrator believes "we need to break down the defined roles and highlight the females that are being productive in technology and engineering and show that you can still be girly and be an engineer. I just don't think our society as a whole does a very good job at that." There is a new dean coming into the school next year and one administrator talked about how this person could be helpful in implementing changes. Whatever comes of this study could be part of this new dean's responsibility.

Administrators believe that if they support teachers and others trying to increase the number of girls in these courses, it will help. They can educate teachers about raising awareness, about which skill sets to look for, and about how to send students forward. Administration can also talk about these skills and courses and encourage students who may have potential in this area to pursue this path. Another idea administration had was to look at what other schools are doing and see if they have increased female enrollment. The school is going for certification in Project Lead the Way, which is an engineering program. This program looks for minorities and females to be in the program so the school feels like they will have to increase these numbers in order to become certified. The school board has told administration that they want the school to have a career day. Administration feels that a career day could also be a chance to bring in people from the community to promote these courses. One administrator stated "I would try to make a conscious effort to find some females, whether they are graduates or whoever are engineers or in the tech world. I don't want them to come speak as the token female but

as the expert in this technology or this sort of engineering." The new dean was also mentioned again as being someone who could help implement these changes.

According to administration, teachers have to do more public relations, recruiting, marketing, and just reach out to students to increase female interests in CSE courses. They also suggested balancing the curriculum for both genders, so that all students are interested in it. Another proposal was to bring women in to talk about CSE, so girls feel like they belong there. Administrators also believe that if teachers advertise and include trendy activities it could increase female interest. According to one administrator, "it has to be cool, out there, and offer something other than just 7:00 to 2:00. There have to be some activities they are doing that are bigger than just a lab during the school day. It has to be sexy. You have to market it." Creating a video of what goes on in these classes may help with any misconceptions. Participants also stated that they would like to see educators start talking about these programs earlier to get kids excited about these courses early and foster the love of these skills. Creating love and excitement may be done by not supporting misconceptions from elementary teachers up through high school teachers. Having stronger female role models at the elementary level who are strong in math and science when students are introduced to these topics would help build confidence at a young age. Another suggestion was to hire a science specialist at the elementary level. Many schools have reading and math specialists, why not science? This focus on science could encourage all students in STEM courses.

Administration would like guidance to do what they want teachers to do, which is to identify strengths that students might not be aware of and have conversations with

them. Having adults be more involved with students will help to encourage students to not have fear to pursue new paths. One administrator feels that adults need to take more responsibility and explain the importance of future careers and opportunities to students. Other suggestions were to have college fairs, career days, bring people in from our school board and community to speak, and visit classrooms to focus on careers. An administrator said that they need to "keep putting it in front of people to see it as an option." Another administrator wished guidance profiled students to see what kinds of interests they have, what kinds of learners they are, what their assets are, what their testing scores and grades are, etc. Their justification was,

> Sometimes you don't even know what your strengths are until you fall into it or guided their by parents, teachers, guidance counselors, or administrators . . . Just for someone to identify a strength, nourish it, guide it, and let it grow . . . It can be life affirming and life changing for both of you. That's the magic of what we do.

Another administrator stated that most of the students in AP math and science are girls and encouraging them to branch out into CSE courses is the next step. Two administrators mentioned the new dean coming in and working with guidance to accomplish this goal.

Articulating goals and giving clear expectations for teachers to institute new policies is something administration feels they can do effectively. They can support but not dictate to teachers about what goes on in the classroom. It is thought that if administration supports teachers, teachers can then support students. Administration can encourage teachers to try different curricula while also encouraging guidance to bring

people into the school or go out on field trips. The new dean was mentioned again as someone to help with this support. Lastly, administration stated that they need to be conscious of what they say and not perpetuate stereotypes. As one administrator put it, "if administration does that [perpetuate the stereotype] then teachers subconsciously perpetuate that stereotype too."

Money was mentioned as an important barrier. CSE courses are expensive with the required software and equipment. Administrators feel they need to make people understand the importance of it to have the community buy into it. One administrator stated,

> We have to do these 21st century skills, engineering, computer, and technology, and it's going to cost money. That's just where the world is headed so we have to spend it. We don't know where they are going to be, but we know we need to prepare them for it.

The stronger the math, science, and engineering is in a school, the stronger the school is and the better its reputation. The better the school, the stronger the community, the more students feel successful. Success stories from within the community may be very inspirational. Another barrier is that schools do not know the jobs they are preparing students for in the future, but they feel the need to explain that STEM is where the economy and opportunities are going to be. Other barriers include the number of seats and courses offered. A concern is that if more girls were interested in these courses then there would be fewer seats or courses available for boys. Then the programs would need to expand, which means more tax money or eliminating other positions. One

administrator could only see benefits. This participant felt that girls are better at math and science so with more women engineers who knows what possibilities we could have with a more well-rounded society.

Administration felt that there needs to be a mind shift in and outside of the school. Placement of classrooms can even be telling of how much it is valued. For example, the engineering class is down a side hallway next to woodworking and feels like a workshop. Having it showcased in the middle of the school with windows would allow everyone to see what goes on in there. It was also mentioned that girls need role models so they can see themselves successful in these types of classes.

Focus Group

During the focus group, all participants had time to think about their responses to their individual interviews. An administrator recalled that the engineering teacher asked about teaching one class a day at the middle school. They are working on aligning curriculum for Grades 6-12, which would be a great opportunity to expose all students to engineering classes earlier. They feel that by ninth grade students already have solidified their interests. Discussions have not been around increasing the number of girls in these courses, just increasing exposure and the number of all students, boys and girls. However, they feel that if they start educating about engineering early, they may change the mindset and preconceived notions about it.

Both teachers and administrators believe teachers marketing their classes will increase the number of students, including girls, in their classes. These two groups also

believe that female interest would increase if the curriculum changes to have non-gender specific activities.

All the groups agree that administration can be supportive of all educators who are trying new things and initiating change. Educators from all groups also realize the problem is not just in their school and feel that the stereotypes and mindsets need to change. They feel that this global problem is something beyond their control. When speaking about their school or their roles specifically, they have more confidence that change can be made. One administrator summed it up like this,

> We need to do a better job in public relations in every aspect of our lives here. We need to really look at how we market our courses to our kids. And not just to have full courses but to ready them for the workforce. What jobs are out there right now? What skill sets do you need to be successful in the 21st century?

Guidance and administration believe that guidance counselors should have career days and stress the importance of CSE classes on future jobs. They felt it was something that all students have to go to. Not a sign up where just those interested in a certain career because that will not expose all students. Exposure within classes students are already in was also discussed. Students are already exposed to certain aspects of CSE in some of their math and science classes, but it may not be presented in a way that is clear. Specific wording and emphasis on topics needs to be addressed, so students know "this is science, but it is also engineering." Guidance would like to see teachers highlight careers associated with each unit. The engineering teacher agrees because he sees science experiments being conducted in the halls that are part of his curriculum. When he sees

that they are already doing it somewhere else, he skips over it in his class. Communication between departments would solve this problem and align curriculum within the school. Administration would like to include the middle school in this communication as well. They would like to see this conversation continue with some face-to-face meetings and a wiki created so educators can give more input.

Outlying data included one interview that was different from the rest. The participant was familiar with humanities, but did not know much about STEM. There was one other administrator who spoke to me personally explaining why she did not want to participate in the study. Her concern was that she too was not familiar with the topic of my study. I tried to encourage her to still participate, but she felt like she would not have anything to contribute. I feel that more people did not participate due to the same reasons. Other than the outlier, educators who chose to participate did so because they had already been thinking about the underrepresentation of girls in CSE courses. The outlying participant did have some good insights and suggestions after some thought about it. He was also very appreciative of learning about this problem.

Themes

There were themes that emerged from the analysis of the data, including all educators recognizing a problem and wanting change. Another theme that was mentioned often is communication and collaboration. Each group of educators had ideas and had tried various strategies to begin the change process. Most did not discuss these ideas or strategies with other educators.

CSE teachers would like guidance counselors, administration, and other teachers to better understand what they do and what goes on in their classrooms. Guidance counselors would like more information from teachers and support from administration. Administration would like an open dialog with all educators. Communication and collaboration within and between each of these groups of educators would allow students to receive consistent, accurate, and helpful direction regarding courses and careers.

Evidence of Quality

This study used the following procedures to address the accuracy of data. Member checking was used. Participants were emailed a transcript of their interview and asked to make any corrections or clarifications as needed. Triangulation with the three types of educators was also used. The same questions were asked of the teachers, guidance counselors, and administrators. These answers were compared to each other to see if there were different views of this problem or different suggestions for change. There were some different viewpoints within and between the types of educators, but at least one participant from each group thought there was a problem in the school regarding the underrepresentation of girls in CSE. Participants from each group had thought about this problem and solutions to it. It was clear from the focus group that all parties are willing to do what they can and have more open communication to help increase the number of girls in CSE in the school.

Outcomes

This study has answered the guiding questions as to what educators' perspectives are on female students' enrollment in CSE courses and what educators' views are about

making changes to encourage girls to be more involved with programming and engineering courses. Educators' perspectives on female students' enrollment in CSE courses believed that there is a problem locally and globally. They agree that the number of boys in CSE courses outnumber the number of girls. Most people interviewed, regardless of years of experience, gender, or STEM experience, have thought about this issue as a problem and would like to see the number of girls in CSE courses increase. Educators' views about making changes to encourage girls to be more involved with CSE courses were also consistent. All participants were not only eager to make changes but also had ideas about what teachers, guidance counselors, and administrators can do to increase the number of girls in CSE courses. They even had ideas about strategies that each of them can do personally but have not tried. Just having these conversations with each other during the focus group was encouraging to everyone involved because they had similar concerns and realized that if they worked together change is possible.

It was clear that everyone interviewed was willing and enthusiastic to make changes so the project will be guidelines and professional development for school wide changes to take place to address the problem of the underrepresentation of girls in CSE courses. Guidelines would include ways to identify female students who have the qualities to be successful in CSE courses. These qualities would include girls with high performance or accelerated math/science courses, good problem-solving abilities, and expressing an interest in computers or engineering. Once a female student is identified there will be guidelines in place to forward that information to the appropriate educator for follow-up discussions with the student. The first step in professional development

would be to increase awareness of what CSE is. The professional development would consist of all educators in the building being aware of the goal of the school, which is to increase the number of female students in CSE courses. Changing the mindset of what these courses and careers are and equal opportunity for all will be part of the explanation of why this is a new goal of the school. All educators will be able to see examples of work that students do in these courses and what types of jobs are available for them if they pursue this as a career. The second step in professional development is to make each department aware of their role in this change, which in part, includes teachers recommending students to guidance that they feel are a good fit with the CSE program. Guidance should be able to explain fully what these programs have to offer. Administration needs to support whatever teachers and guidance needs from them to accomplish this change successfully.

Section 3: The Project

Introduction

Professional development will be the project for this study. Three modules will provide professional development for teachers, administrators, and guidance counselors. It will involve training, collaboration, and communication within and outside of the school. Time for three professional development days throughout the school year will be required. Each module will be evaluated based on post self-assessment and reflection sheets.

Description and Goals

The project for this study will consist of professional development for all educators at the school studied. The overall goal of this project is to increase the number of girls taking CSE courses. In order to accomplish the overall goal, subgoals need to be achieved, including raising awareness of gender bias, becoming cognizant of attitudes and terminology used, educating about what CSE is, experiencing what goes on inside classrooms, and informing about careers.

The first module consists of professional development for all educators. It will focus on self-awareness regarding gender bias in teaching, closing the gender gap in science and engineering, and brainstorming and sharing ideas. Each educator will be asked to reflect on various habits in the classroom. Are boys and girls treated differently? Does the curriculum unknowingly have bias material in it? Activities will raise

awareness of gender bias and require a second look at how educators handle themselves, what they say, and what their curriculum demonstrates. Educators need to learn to use the correct terminology to inform all students that they have equal opportunities regardless of gender. Similarly, they need to be positive and confident in their language. For example, teachers should not be telling students that math and science are hard. They should be encouraging that all students can be successful in these areas.

Common language also includes terminology in all STEM (science, technology, engineering, and math) areas. As discussed earlier, teachers are already teaching bits and pieces of CSE in other courses, such as math and science. These sections need to be pointed out to students so that they can understand what is involved in these courses and recognize that it is not that different from what they are already studying. In order to do convey this knowledge effectively, educators will be trained in what exactly CSE is, what the courses cover, and what types of careers are available in these areas. Once educators better understand the content of these courses and the types of career opportunities they present, then they can begin to make all students aware of this information and what the school can do to help them.

Each educator will leave the first session with a self-observation assignment they must complete over the following week. After the self-observation, they must conclude with a post self-assessment to measure any changes in attitude or behavior.

The second module of professional development is designed to increase communications within the school, which entails administrators and guidance counselors rotating through classrooms. Each teacher will share an overview or demonstration of

what each of their courses involves. This information will clear up any misconceptions about courses, curriculum, and teachers. Not only will administration know what is going on in their building but the information will allow guidance to properly and knowledgeably guide students. Counselors will be able to hear, see, and experience first-hand teachers, courses, projects, and exams. They can also take their own notes that they can refer to when counseling a student. Guidance counselors and administrators need to meet with teachers to gain a better understanding about what goes on in each class. They are the main liaison between students and the courses they choose.

The third module involves communication with the community. Having a career day permits community members to come in and inform educators about the diverse jobs available, what these jobs entail, and what courses are important in getting these jobs. A career day will educate everyone about all the possibilities students have. Teachers can relate these careers to their curriculum. Guidance counselors can disseminate career information with students. Administration can connect with the community and possibly make course and curriculum changes to fit the ever changing job market.

Administration needs to set clear goals of what they want to happen and provide support to all educators. They need to let teachers know that the goals are better communication, mindfulness of gender issues, increasing awareness of CSE, and growing the number of girls in these courses. Although it is already a technology driven school, educators need to understand that increasing the numbers of students in CSE courses will make the school more visible to others in the community and show that all students are being prepared for a technological future. The engineering program is already preparing

to make changes as the school gets ready for certification in Project Lead the Way (PLTW). PLTW provides a "hands-on, rigorous" curriculum to students in engineering (Lawanto, Santoso, & Liu, 2012, p. 154). It also provides course-specific professional development and must approve teachers before they are allowed to teach the curriculum (Daugherty & Custer, 2012). The program partners the engineering program in the school with local industry. One of the objectives of the program is to increase the number of minorities and women in engineering. The rest of the school needs to be aware of PLTW, how the program connects the school to industry in the community, and what educators in the building can do to support this endeavor.

Rationale

Most educators involved in this study had similar thoughts and goals of increasing the number of girls in CSE but were not successful with making desired changes. The data from this study have shown that the educators involved are willing to communicate and work together to increase the number of female students in CSE courses; however, there was a lack of understanding how to accomplish this goal. The project that is best suited for this project study is professional development for all educators. After the three modules are complete, all educators will be better informed about themselves, their colleagues, what is going on in the building they work in, and in the community in which they live.

The problem will be addressed through the content of the project by educating teachers, guidance counselors, and administrators about the underrepresentation of girls in CSE courses. They will understand that this problem is present in their school as well

as others. They will read and watch a short video about this problem in schools and learn techniques that they can use to combat this problem. These educators will also learn about CSE as it pertains to their school, their courses, and the workforce. Participating in this professional development will allow all educators to gain a similar knowledge that then can be transferred to students consistently. In turn, students, especially those who have limited knowledge or have previously been reluctant about these courses, will benefit from this knowledge. Professional development is the best way to address the problem of the underrepresentation of girls in CSE. It will allow the various types of educators to be trained, become aware of their current practices, and learn how each group of educators can collaborate with the other educators in their building and within the community.

Review of Literature

This literature review was conducted predominantly using Walden University's online library. Various types of professional development were searched including teacher, guidance counselor, and administrator professional development. Math, science, technology, computer science, and engineering training were also explored. Professional development regarding design, effectiveness, communication, collaboration, attitudes, growth, changing mindsets, and gender was investigated as well.

Professional Development

According to Learning Forward (2014), the main goals of professional learning are to affect the practices of the educator and to increase the learning of students. Changing the outlook of educators to realize their influence on girls in CSE courses

would in essence be changing educators' practices, which in turn will increase the learning of these female students. Successfully meeting these goals requires time and support. Learning Forward also described effective learning designs to include active engagement, reflection, application, feedback, and ongoing support. Educators will need to be actively involved in their training to benefit from it. They will need to reflect on how they perceive and treat students of both genders. Application of the learning will be essential to creating change. Feedback will allow all educators to reevaluate their strategies and adjust if necessary. Lastly, support must be ongoing so that the goals of the learning are not forgotten.

Changing the mindset of these educators will in turn change the mindset of students. Students need to perceive themselves as problem solvers who can accept any challenge (Pawlina & Stanford, 2011). An essential element of this training is for educators to perceive all students equally as problem solvers. According to Akiba (2012), two types of professional learning programs include professional development and collaboration. Akiba also defined professional learning as "cognitive changes in . . . knowledge and beliefs" (p. 3) but this "learning is not guaranteed solely by their participations in these activities" (p. 3). Professional development should provide for teacher growth and collaboration (Lee, 2010). Lee also stated that professional development should form a shared vision and create a community. All educators in the school must learn and support change (Vermont DOE, 2011). In order for the entire school to come together and do their part in increasing the number of girls in CSE

courses, they must all buy into it. Each educator needs a complete understanding of their part and how it all comes together in achieving the result.

Professional development should also address concerns recognized by the educators themselves (Marra et al., 2011). Many of the educators involved in the study have "first-hand knowledge of strategies and programs being implemented and are an invaluable source when planning professional development" (Varela, 2012, pp. 19-20). Bringing these people together to discuss and develop a plan to implement specific strategies about how to achieve their goal is important for the success of the project. Including teachers and guidance counselors in the decision making process is critical to their comfort level and participation. According to O'Meara and Terosky (2010), professional growth includes learning and professional relationships. These relationships are reinforced through common learning and are important to intellectual growth. As the study showed, the process in place right now for course sign-ups is ineffective for all courses, not just CSE courses. However, it is especially noticeable in CSE courses because they are electives that students and other teachers in the building do not know much about. Learning how to improve communication between all educators is vital in providing students with correct and helpful information about what courses entail and what is best for each student.

Collaboration

Riveros (2012) advised administration to remember teacher learning and knowledge when attempting school reform. Riveros also stated that teacher learning is important to making changes in schools, which includes "peer collaboration."

Collaboration is defined as shared responsibility working toward a common goal (Brown, Brewster, Karides, & Lukas, 2011). In the case of this study, administration may not necessarily be making decisions about the specific steps involved getting to the common goal, but they need to relay these goals to everyone so that all the educators will know what they are striving for and why. Administrators should support interactions between colleagues that allow them to help each other in finding resolutions to problems (Eson-Brizo, 2010). Adequate time is necessary for this collaboration.

One of the barriers to this project includes a challenge for collaboration time (Murphrey, Miller, Harlin, & Rayfield, 2011). Administration must agree to set aside time for this professional development to be successful. This time would allow the various types of educators to get together to participate in the professional development modules. In this study, the participants have already expressed ideas to implement change. The problem has been that each educator had their own opinion about how to achieve this change, and it does not necessarily coincide with the other educators' views. Although these ideas may all be a step in the right direction, implementing each change individually is not enough to see results. Collaboration is important in making new procedures within the school and then having these procedures impact students, or in this case the number of girls in CSE courses.

Custom Goals for Each Educator

The professional development for teachers needs to guide them to understand the need for the change and the steps necessary for this change. According to Petrie and McGee (2012), professional development "ought to focus on teachers as both learners

and teachers" (p 70). They also stated that there are a couple of goals linked especially to teacher professional development. These goals include "the goal of designing and implementing professional development that increases teacher learning" (p. 69) and "the goal of simultaneously meeting outcomes associated with student learning and achievement in specific classroom contexts" (p. 69). This information translates into training that is "targeted for and deliver proven results for students—real learning gains and skills that make them competitive in the workplace" (Pianta, 2011, p. 2).

Guidance counselors will need professional development that is similar to the teachers. According to Johnson, Rochkind, and Ott (2010), guidance counselors are adults "trained to offer advice, options, and assistance" (p. 74), which is crucial because "students who don't have access to good counseling are not making the most advantageous choices about postsecondary education and work" (p. 77). This professional development must ensure that counselors are trained to give the best advice. Ediger (1991a) stated that counselors should work with teachers and participate in curriculum development. Ediger (1991b) also defined the role of guidance counselors to include not only helping students, but it also helping teachers to help students.

Students in this school often go to guidance counselors looking for advice about which courses and career paths to take. Unfortunately, it depends on the individual knowledge of each counselor and specific information can be hit or miss. Professional development for all guidance counselors will give them more information about courses and careers, which will then lead to more information students have access to. According to Chinedum, Onwuasoanya, and Eze (2012), "school guidance counselors . . . can

contribute seriously to national development" by providing "proper perspective, exposure, and orientation to the world" (p. 1045). Guidance counselors need to be aware of not only what is going on in the world around them, but also what is going on in their school so that they can provide helpful guidance to students.

Professional learning for administration will need to be more of a collaboration. It is the responsibility of administrators to clearly communicate the school's vision and goals (Rieckhoff & Larsen, 2012). Then they must be responsible for creating an encouraging atmosphere, which motivates other educators to achieve these goals (Adegbessan, 2013). Administrators will need to understand their role in implementing change and support teachers and guidance counselors in order to be successful. The will also need to ensure that conditions exist to ensure effective implementation of the professional development plan.

"In order to change educational practices at school, teacher training must be a main priority" according to Alvarez-Alvarez, Fernandez-Diaz, and Osoro-Sierra (2012, p. 521). They also discussed that the two main objectives of training is "to change educational practice" and "to generate knowledge in action." The goal of this professional development is to change the practice of how educators refer to CSE and generate more girls into these courses. High quality professional development needs "collective participation" (Blank, 2013) so in order for training to show the greatest results, all educators must participate. Varela (2012, p. 20) stated "professional development that fails to incorporate teachers' input . . . will not provide effective and productive learning experiences." According to Patti, Holzer, Stern, and Brackett (2012,

p. 264), "effective professional development happens when the adult learner connects personally to the new learning." This training must express to all educators the importance of this change and show students the entire school is committed to this improvement. Administration motivates teachers and guidance counselors. Teachers and guidance counselors motivate students. It is a process that requires an involvement from all levels.

Zaman (2008) conducted a study regarding gender sensitive teaching which used an Attitude about Teaching Scale (ATS) and a Reflective Based Observation (RBO). The ATS is a questionnaire for educators to see how gender sensitive their attitudes are. There are questions about boys and girls regarding behavior, preferences, curriculum, etc. Answers can be checked against a rubric so that each educator can see how gender sensitive they are. The next step would be for each educator to do the RBO, which allows for self-reflection. There are several scenarios given and the educator must observe boys and girls behaviors during these scenarios and then observe how they react to these behaviors. The ATS and RBO (Appendix A) will be included in the professional development plan because it will allow educators to begin to think about their own feelings and reactions to gender issues. Awareness is the first step toward change.

Description

The professional development plan (Appendix A) includes training to increase communication, knowledge, and ideas throughout each department. For example, it was determined that the guidance department needs more information about courses offered in the school but it was not decided upon how this transfer of information should happen.

Before this study, educators from each department had thought about the underrepresentation of girls in CSE courses but were unable to make changes on their own. During this study, participants were encouraged to hear that others in and outside of their departments felt the same. This chance for open communication and collaboration between the departments is critical to implement the right changes that they decide will work for them.

All educators have a role to play. Teachers will receive training to understand the importance of using the correct terminology in the classroom and to explain when a topic is an engineering or computer science topic. They will also be taught to use language that does not condemn women or criticize math and science. Teachers and guidance must work together and have open lines of communication. Guidance has a duty to students to give them the best information they possibly can regarding courses and careers. They will receive training that gives them this information. Training will include knowledge of current and up-coming jobs and what previous knowledge is required for these jobs. It will also include specific examples of what is going on right in their own building. Lastly, it is essential that administration support what everyone else is doing.

Needed Resources

Resources needed include time and space for collaboration and training. There will be a day of training for all educators. They will also be asked to evaluate themselves over the following week to look for behaviors, attitudes, and signs of gender bias in their classrooms, curriculum, and general conversations with students. Training will include

some reading material, videos, and discussion. Handouts, a computer, and projection equipment will be required for this day of training. Another day will be required for in-house classroom visits, which will allow guidance and administration to learn more about what goes on it classrooms so they can better assist students will course selections. Lastly will be another day dedicated to career education. Having a career day will not only inform students, but will be valuable to all educators in the building. Cooperation and time needed for these events is critical to the success of the project.

Existing Supports

Existing supports consist of cooperation among all departments. As the study showed, people are willing to move forward with changes and are excited about change, which is a significant support. Backing from all involved is crucial to making this work and to the success of the project. Each of the educators involved has the potential to grow personally and professionally from this knowledge. Self-evaluation that makes one realize something that they may have been doing is eye opening. Being open to this growth is the first step in making changes.

Potential Barriers

Time is the biggest barrier. Lack of time is often an issue in education. There is always so much to do and not enough time to do it. Administration needs to be committed to this professional development to dedicate three days of training. Another barrier would be scheduling community members to come in for the career day because it will take much time and effort. Discussing the career day as a school may help the process so that any educators and students who know of someone who may be willing to

come in and speak can arrange it. The more people involved in the planning, the more diverse the careers and the participants of the career day. The challenge will be to get everyone there on the scheduled day. This barrier will also require commitment and dedication.

Implementation

Implementation of the project can begin immediately and will take some planning and scheduling of dates. The three days of professional development can be spread out over the school year. It could take at least a year or longer to see the results and if it translates into increased numbers of girls in CSE. The school would not know until it sees the number of girls enrolled in these courses. Teachers would need reminders every year of this goal and the strategies to achieve the goal.

Roles and Responsibilities

Each educator has a role in this project and shared responsibility to make it successful. They must take part in the training, the in class learning, and the career day. Specifically, teachers must allow guidance counselors and administrators into their classrooms to discuss what their courses entail and provide descriptions and examples of coursework and projects. Guidance counselors will be primarily responsible for organizing the career day and scheduling community members as speakers. Administration must organize each of these events by scheduling times and places for all training. My role will be to conduct the training on the professional development day and check in with each group of educators to be sure the scheduled events are ready and run

smoothly. I will also be looking over the evaluations to see how effective the training was and what can be done differently next time.

Project Evaluation

The evaluation of this project is outcome based. At the end of the first module in Appendix A, participants will do a self-observation and then complete a self-assessment to determine if there were any attitude or behavioral changes after completing the first phase of professional development. After modules two and three there will be a reflection form to fill out. This reflection will determine what participants have learned, what they found valuable, what they still have questions about, and, lastly, if and how they will use the information they learned. Lastly, there will be a wiki for teachers to contribute to. The wiki will allow all teachers to get ideas from each other regarding ways to incorporate CSE skills and terminology into their courses. It also allows guidance and administration to gather this data and help direct teachers who are struggling. Follow through of these ideas can be tracked to be sure everyone is doing their part to help educate about CSE.

Only when the school confirms that the numbers of girls in CSE courses increased, will it know that the efforts of all the educators involved were successful. It may be a gradual increase over an extended period. The problem discussed in the study was the underrepresentation of girls in CSE courses. Any significant increase in the number of girls would be considered a success.

One of the reasons professional development is not always successful is because it is one-shot training without any follow up (Daugherty & Custer, 2012). Part of the

evaluation process needs to include continuous training as deemed necessary. Administration should allow time for procedures to be reviewed every year so educators can see that it is considered an important initiative the school is undertaking. Numbers of girls in CSE courses need to be given to all educators so they can see the results of their efforts. Improving results could be a motivation to continue with procedures or make changes to increase the desired results. As more girls begin to sign up for CSE courses, educators will feel that their work has paid off, and they have all collectively made a difference.

Justification

Outcome based evaluation determines if the project has reached its desired results and shows if the project has made a difference and made lives better because of the project (Foundation Center, 2014). Using an outcome based evaluation for this project was best because if the result does not increase the number of girls in CSE then the project was not successful. Results reported back to the school will provide answers to questions, including if educators' attitudes and actions have changed, as a result of their training. It would also determine if educators increased their communications in and out of the building in which they work. Ultimately, decisions can be made about improving the specific details of the professional development.

Outcomes and Performance Measures

Short term outcomes and performance measures include educators' attitudes and behaviors related to CSE courses and gender inequalities in the classroom, which will be measured through the evaluation process and follow up discussions. Determining how

many educators made changes in their classrooms based on knowledge gained from the professional development will gauge how successful this training was. Assessing which parts of the training were most effective is imperative moving forward.

Long term outcomes and performance measures consist of increasing the number of girls in CSE courses in the building. With positive short term changes in educators and classrooms, it is expected that more girls will take CSE courses. Enrollment numbers in these courses will measure this change. Any increase of girls would be considered a success of the project.

Evaluation Goals

There are several goals of the evaluation process. They are to:

- Determine if all educators know what CSE is, what is done in CSE courses in the building, and what kinds of jobs are related to these courses.
- Have all educators be aware of gender inequalities in the classroom and in the curriculum.
- Put into practice a common language for CSE in all classes.
- Ultimately increase the number of girls in CSE courses in the building.

Key Stakeholders

Key stakeholders include teachers, guidance counselors, and administration. Other important stakeholders also include community members because success of at least part of this project needs their support. These people will potentially be guest speakers to teach faculty, staff, and students about what they do and what educators can do to help students acquire the skills they need to achieve their goals and become

successful. This project is a community project and will require cooperation and involvement from all to succeed.

Implications Including Social Change

Local Community

Increasing the numbers of girls in CSE courses at this school will help the girls in this community to have more job options. Taking more CSE courses allows girls from this school to have an advantage over girls from neighboring communities because they will be exposed to and have experience in CSE. This exposure will provide opportunities to them in college and in the workforce that other girls will lack.

The community may also change their view of this school as a more technologically advanced school. Once word gets out that more girls are taking CSE courses and more girls from this school are going into these fields as opposed to surrounding towns, the public will form an opinion about what kind of school it is and what goes on there. Parents may want their daughters to go to this school, especially if they are interested in technology. The school could have more students because parents and students may stay in the public school system rather than transfer to private schools. It may even make the district a more desirable place to live if it is perceived as a cutting-edge school providing equal opportunities for all students. This study has the potential to affect the local community dramatically.

Far-Reaching

Should this school see their number of girls in CSE rise, they could be an example for other schools. If more schools could follow the same process, it could mean a larger

population of girls from all across the United States and beyond would be exposed to CSE courses. As more and more girls become interested in these courses at the high school level, the number of girls in colleges majoring in CSE would increase. This increase, in turn, would raise the number of women in these careers, provide more job opportunities for girls, and essentially change the CSE fields with more female influences.

Conclusion

Professional development will put all educators on the same path for implementing change in their building. Each department has a role to fill so that collectively they make a school-wide transformation. Evaluation will determine if educators have learned from and changed their beliefs and attitudes based on the professional development. As each semester passes, and there are more girls in these courses, it will be clear if the project is successful.

Section 4: Reflections/Conclusion

Project

Strengths

The project's strengths in addressing the problem are that, at the very least, all educators will be exposed to the problem of the underrepresentation of girls in CSE. As Skouteris, Watson, and Lum (2012) stated, "A knowledgeable and skillful teacher makes the greatest impact on student learning achievements" (p. 78). If some of these educators were not aware that a problem existed, it will be brought to their attention, and they will be asked to think about it, if they may be contributing to the problem, and talk about possible solutions to the problem.

Another strength of the project is that creating an environment for open communication will not only benefit girls in CSE classes but all students in all classes. The career fair will showcase all types of careers, not just computer science or engineering. Educators are not only responsible for teaching students but also for advising them in their career choices (Mahon & Packman, 2011). The in-house walk-throughs will allow guidance counselors and administration to learn about all courses in the building, not just computer science or engineering. This collaboration has the potential to benefit all educators and students in some way.

Limitations

Limitations of the project include elements beyond anyone's control. For example, educators who are absent during a professional development day will miss out

on what was covered that day. They can get the material, but it will not be the same as being there and experiencing it. Another limitation would be the extent of effort and honesty the participants are willing to give, which includes filling out worksheets about how they treat students and doing the post self-observations. The educators could do this self-observation half-heartedly and not get as much out of it, or they may not be willing to see themselves objectively. Lastly, the career day could be the limited by the community members' careers and willingness to participate. It may not be possible to find people from all careers the school is interested in showcasing. It also may not be possible to find enough people willing to share their knowledge with others, which would be a limitation to the project because adults influence students' college ambitions (King, 2012). These limitations may be able to be overcome by stressing to educators and the community the importance of this project and how it will affect students. As long as the strengths outweigh the limitations, the overall project can be successful.

Recommendations

This study approached the problem of the underrepresentation of girls in CSE by interviewing educators for their perspectives on the subject and how willing they were to make changes. An alternative way to address this problem would be to interview students to see their perspectives on why they are not choosing to take these classes. The results of that study would determine if the students, parents, and educators need training to become more knowledgeable about the subject matter. The professional development may be more along the lines of workshops for everyone in the community to understand the problem and address the specific issues that students put forth.

Analysis of Process

Scholarship

The process of this research development has shown scholarship in unexpected ways. Even throughout the interviews it was clear that the participants were passionate about this problem and were excited about the idea to come together and do something about it. Each of them learned that others had also recognized this problem and had different ideas about how to overcome it. They were enthusiastic about hearing ideas and finding new ways to collaborate. It was also eye-opening to administration to find out some of the struggles teachers and guidance counselors have been experiencing. The learning process had already begun at the time of the interviews and focus session. The next step is to involve everyone else, not just the participants of this study. The extra problem that is posed by expanding into the general school community is that they are not as familiar with CSE so they will need to understand that aspect of it first. A good feature of the project is that it allows everyone, not just educators and students involved in CSE, to benefit from this professional development.

Project Development and Evaluation

The development and evaluation of the project came about after the interview process, which showed that teachers needed to know more about ways to get rid of gender bias in their classroom and curriculum. Guidance needs to communicate with teachers more so that they know what is going on in classrooms so they can tell students. Administration needs to oversee and support all that is going on. Lastly, all the educators need to become more knowledgeable about what the workforce looks like and what skills

are needed. The goal of any high school is to make its students college and career ready. It seemed to be clear that the project needed to be professional development for all educators. The goal is to increase the numbers of girls in CSE, so the only way to evaluate if the project is successful is to track the numbers from semester to semester.

The process of developing the project and evaluation was to create a professional development plan, which is similar to creating a lesson plan for a student project. Online resources were found and incorporated. Providing variations in instruction is important to keep the participants' interest so it includes filling out worksheets to reflect on their own practices, reading, discussing, providing statistics, watching videos, and leaving with something to do and think about. The other days of professional development include communication that proved to be a missing key element during the interviews. Like any other lesson plan, this professional development needs to be done once to see where the high and low points of the lessons are and then improve upon it for follow-up trainings.

Evaluation is important to any professional development because it is what determines what worked and what did not work during the training. Listening objectively to what participants and organizers have to say will drive the changes to make the next training more effective. Modifying the training allows for adjustments so that educators can get the most out of it and, in turn, students can benefit from it.

Leadership and Change

Leadership was evident in various places throughout this process. During the interviews, each of the educators was willing to become a leader in this endeavor. They were prepared to be part of a leadership team to create change. They also looked to me

for leadership because of the research I have done. Becoming more of a leader amongst my peers has become a directive in my goal setting plan. Change can come from anyone who has a passion about something. I have learned that I am lucky enough to work in a school where that is embraced, and I am fully supported.

Learned About Self

Scholar

Before I began research on the underrepresentation of girls in CSE courses, I knew this was an important topic to me. Although I am not a computer science or engineering teacher, I do teach technology courses. I also have two daughters, one of whom is interested in CSE. As I began research, I saw that it is a bigger problem than I realized. It is a global problem not only in schools but industry as well. This problem was frustrating to me, frustrating enough to want to do something to make a difference, even just locally. I have learned to focus that energy on this study.

Lifelong learning is something I believe in wholeheartedly. This process has been the most I have ever learned from any program I have taken. Not only have I learned the ins and outs of doing research and creating a study, but I have shown myself, and hopefully others, how dedicated I am to my own education and the education of others. I look forward to this study being my first step toward many studies and various small assists toward social change.

Practitioner

Constantly learning new things is nothing new for a teacher, especially a technology teacher. We must continuously update our skills and knowledge to keep

current with the students and technology. Since beginning this process, I have learned to look for the essential information that will truly help the students. Teachers are in this profession because they want to help and make a difference in the lives of students and the future. This process has taught me that we can make an even bigger difference with a little extra effort, some research, and a plan.

Using social networking in a scholarly way has given me information daily about the most recent findings in my field and my interests. I have learned more to share the information I find with others in my field. We have had great conversations, ideas, and camaraderie from these encounters. Keeping abreast of new research has made me a better teacher, colleague, and student.

Project Developer

Developing this project has made me hopeful that change is going to happen. It may start as small changes in our school and then become bigger and wider changes branching out into other schools. A project developer has a phenomenal task of choosing a problem, providing research and statistics, conducting a study, analyzing the data, creating a plan of action, and following through to see change happen. I have placed so much time and effort on this project being successful, that failure is not an option. I will work with the school and make changes as necessary to see this project succeed. In the past, I would not have gone to administration and proposed changes but after conducting this research, I am confident that this change can happen.

Reflection

I believe this project study was important in many ways. Like so many other periods throughout history, this particular topic is in a growing phase. Society as a whole needs to view women in CSE differently. This change must start in our schools so the culture change will start here. Teachers are on the front lines of this change. Teachers can learn best practices to increase the numbers of girls in CSE. These practices will hopefully translate into more girls in these courses. Not only does this project help these girls but it shows all other girls and boys in this school that it can be done. They will take this knowledge with them into the workforce and continue to create change, one person at a time. This study has shown that with communication, collaboration, and a willingness to improve, a community can come together and attempt to make a difference.

The study did show what educators' perspectives are on the underrepresentation of girls in CSE. Learning that teachers are so agreeable to do what they can to see change happen is very encouraging. This cooperation may not be true for all schools and all educators but if we can make a small change here, it may grow. The teachers, administrators, and guidance counselors that I have worked with have been very inspiring to me. I hope that students not only see and appreciate what these caring educators are trying to do but also benefit from it as well.

Future Research

As the job market continues to change, education must try to be a step ahead so that students will be ready. This progress is even more applicable when it comes to technology such as CSE. It is not fair to be only training half our students for these

skillful careers. Not only should schools teach skills such as these but they should also be training students as innovative and future thinkers, which requires educators to be innovative and futurists. Technology may not even be the most important aspect of CSE education. It may be understanding our biases and practicing equality.

The future of this project would include communication and collaboration to find ways to increase the number of girls in CSE courses and careers. If results of this project are unsuccessful, I hope the school continues to try to experiment with ideas until they see a change. I also hope this idea spreads to surrounding communities and grows. Each school may find that different strategies work for them. The path to get there may change, but the goal must be the same: increase the number of girls in CSE courses and change the attitudes and beliefs about women and CSE.

Future research could consist of comparing perspectives of educators from various communities. Are they different in affluent and poor areas? Are they different in large and small schools or towns and cities? Do they change in different countries? Because we know that the problem is widespread, it would be helpful to know how a wider view of educators would react. I believe that change is possible if the educators are willing to create change. However, if educators are not willing to cooperate, it would be much more difficult. Knowing educators' perspectives from all different scenarios would help researchers know what they have to work with and what they have to do. It may be a challenge, or it may be a pleasant surprise.

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Appendix A: Project

The project consists of three professional development modules. These modules will all be completed during professional development days throughout the year. The school usually has about three professional development days per year. The first will be completed during the first professional development day of the year, which is typically the first or second day back to school before students begin school in August or September. When this first module is finished the participants have a week to carry out a self-observation. They must then conclude with a post self-assessment, which will be due back no later than two weeks after module one. Module two will be conducted during the second professional development day of the school year, which may happen in about January. The evaluation will be complete before they leave for the day. The last module will be organized during the next professional development day, which would be around April. Again the evaluation will be done at the end of the day. Having this project start at the beginning of the year will give ideas to educators right from the start. Continuing throughout the year will reinforce the importance of it and remind everyone involved that it is a continuing goal.

Professional Development Module 1 - Awareness

Goals:

- To raise awareness of gender bias
- To become cognizant of attitudes and terminology used

Participants: all educators in building

Activities:

- Self-Assess
  - Complete the Attitudes about Teaching Scale (ATS) - Boys handout (Zaman, 2008)
  - Complete the Attitudes about Teaching Scale (ATS) - Girls handout (Zaman, 2008)
- Gender bias
  - Read the following article about gender bias in teaching: http://www.education.com/reference/article/gender-bias-in-teaching/#A
  - Read the following article about gender bias in education: http://www.edchange.org/multicultural/papers/genderbias.html
  - Get into groups of 4 or 5 and turn and talk about the articles. They can discuss if they have seen or experienced gender bias in class including teacher unconscious gender bias or in books or curriculum.
- Gender gap
  - Watch this video on closing the gender gap in science and engineering http://www.youtube.com/watch?v=gP-tkOmQqd4
  - Give statistics on the number of girls and boys in higher level math and science classes
  - Give statistics on the number of girls and boys in CSE classes
  - Refer to references in this study and anonymous participants' thoughts from the interviews and focus group to show possibilities about why these numbers are what they are.
  - Brainstorm ideas in small groups about how we can change those numbers. Each group will write their ideas on posters.
  - Have each group share their ideas with the larger group.
  - Each group will hang their poster and everyone will do a gallery walk through to read each poster and allow for these ideas to be compiled for future use.
- Self-Observe

    - Do the Reflective Based Observation (Zaman, 2008) handout over the next week
    - Complete the following gender sensitive evaluation of the next week http://www.unifr.ch/didactic/assets/files/didactic/Eval_course_gender_en.pdf
- Self-Assessment
    - Participants will be asked to individually and privately compare their original self-assessment from before any training to this self-assessment. Have their thoughts and ideas changed?

Professional Development Module 2 – Communication with Community

Goals:

- To educate about what CSE is
- To inform about careers, what they involve, and what knowledge they require

Participants: all educators and students in building

Activities:

- Career Day
  - Have a career day that is not just for students but allows all educators to attend as well. Various community members, of both sexes, and from all types of careers will come in and talk about what they do and what courses were important in getting there.
- Engineering
  - Watch this video on engineering courses, jobs, salaries, etc. http://www.youtube.com/watch?v=zD_zWHu1msY
  - Explore the following website with the various types of engineering careers and which courses are necessary to becoming each of the engineering specialties http://www.typesofengineering.com/
  - Educators will turn and talk with their colleagues about what they just learned about engineering. They will also discuss courses or topics they cover in their own classes that would help students interested in this area.
- Computer Science
  - Watch this video on computer science jobs and the demand for them http://www.youtube.com/watch?v=yUTgCACDuUA
  - Read the following article regarding computer science education requirements http://www.educationrequirements.org/computer-science.html
  - Educators will turn and talk with their colleagues about what they just learned about computer science. They will also discuss courses or topics they cover in their own classes that would help students interested in this area.
- Complete reflection form
- Job Shadow
  - Now that educators have met members of the community, they can schedule a job shadow with at least one of their choice. They will need to spend at least two hours there to learn first-hand about what goes on in these companies.

- Each job shadow participant will need to write a reflection about how they can incorporate what they have seen and learned into their courses and curriculum.

Professional Development Module 3 – Communication within Building

Goals:

- To educate about what CSE is
- To experience what goes on inside classrooms in the building

Participants: all educators in building

Activities:

- Dedicate a professional development day to allow administration and guidance counselors to come into each classroom for a demonstration and overview of what each course involves. Each teacher will also provide a syllabus, examples of major projects, and the final exam for each course that they teach.
- Have question and answer sessions to clear up any misconceptions
- Online Poll
    - Have all female educators take an online poll to see which department/courses they would enjoy taking after experiencing all courses today.
    - Have all male educators take an online poll to see which department/courses they would enjoy taking after experiencing all courses today.
    - Compare polls of boys and girls to see if there are trends among educators about course preferences (math, science, computer science, engineering, etc.)
- Complete reflection form
- Wiki
    - Based on the above training, each teacher will contribute to a wiki site regarding how they can incorporate CSE skills into their courses. These contributions can be actual lessons or just relating topics/skills learned to careers.
    - After wiki site is done, data will be compiled by guidance counselors and administrators and follow up with teachers to see that these ideas are followed through.
    - The wiki can also be available for K-8 teachers as well so they can see what the end goal is by grade 12. They may be able to get ideas so that each of them may be able to touch on these topics with younger students.

Attitudes about Teaching Scale (ATS) - Boys

Directions: In the previous scale, there are 10 statements about teaching children. There are no right or wrong answers to these statements. Please indicate how much you agree or disagree with each statement by placing a check (☑) mark under the appropriate response. While some of the statements may seem repetitious, take your time, and try to be as honest as possible.

Legend for Chart:
A – Statements
B – Strongly Agree
C – Agree
D – Not Sure
E – Disagree
F – Strongly Disagree

A	B	C	D	E	F
I believe boys are uncontrollable in the classroom					
I believe boys are too aggressive during play, when compared to girls					
I believe boys are suspended from school more than girls					
It is more challenging to teach boys					
I look forward to teaching boys					
Teachers should have the same classroom activities for boys and girls					
Boys have less concentration when learning compared to girls					
Boys need more attention during classroom activities than girls					
If boys engage in more physical activities during play, they will concentrate better during academic activities					
Boys are easily distracted while working in groups					

Attitudes about Teaching Scale (ATS) - Girls

Directions: In the previous scale, there are 10 statements about teaching children. There are no right or wrong answers to these statements. Please indicate how much you agree or disagree with each statement by placing a check (☑) mark under the appropriate response. While some of the statements may seem repetitious, take your time, and try to be as honest as possible.

Legend for Chart:
A – Statements
B – Strongly Agree
C – Agree
D – Not Sure
E – Disagree
F – Strongly Disagree

A	B	C	D	E	F
I believe girls are easy to control, while in the classroom					
I prefer to teach girls rather than boys					
I believe girls follow directions easier than boys					
I believe girls are more interested in classroom learning rather than boys					
Teachers should have the same classroom activities for boys and girls					
I look forward to teaching girls					
Girls need more attention during classroom activities than boys					
Girls work well in group learning activities					
Girls need more nurturing attention than boys					
It is more challenging to teach girls					

Reflective Based Observation

Legend for Chart:
A – Subject
B – Duration
C – Context: When and where to observe
D – What to observe

A	B	C	D
Boy	3 – 5 minutes	Choice time, open activity	What the boy does and how he interacts How the teacher reacts
Girl	3 – 5 minutes	Same as above	What the girl does and how she interacts How the teacher reacts
Boy	3 – 5 minutes	Meeting time, seat work, teacher directed group activity time	What the boy does and how he interacts How the teacher reacts
Girl	3 – 5 minutes	Same as above	What the girl does and how she interacts How the teacher reacts
Boy	5 – 7 minutes	When freely can choose peer-partner	Note the activity and how the boy initiates it, nature of his interaction (positive, negative, neutral). Note the peers who initiate interactions with him; whether he responds and if so, the nature of the response (positive, negative, neutral). How the teacher reacts to the boy's behavior/interaction with peers.
Girl	5 – 7 minutes	Same as above	Note the activity and how the girl initiates it, nature of her interaction (positive, negative, neutral). Note the peers who initiate interactions with her; whether she responds and if so, the nature of the response (positive, negative, neutral). How the teacher reacts to the girl's behavior/interaction with peers.

Self-Assessment – Module 1

Directions: There are no right or wrong answers to these statements. Please indicate how much you agree or disagree with each statement by placing a check (☑) mark under the appropriate response. While some of the statements may seem repetitious, take your time, and try to be as honest as possible.

Legend for Chart:
A – Statements
B – Strongly Agree
C – Agree
D – Not Sure
E – Disagree
F – Strongly Disagree

A	B	C	D	E	F
Boys and girls are similarly controllable in the classroom					
I prefer to teach girls and boys equally					
Boys and girls are capable of following the same directions					
Girls and boys are both interested in classroom learning					
Teachers should have the same classroom activities for boys and girls					
Girls and boys need the same amount of attention during classroom activities					
Boys and girls work well in group learning activities					
Girls and boys need the same amount of nurturing					
During my self-observation:					
When given choice time during an open activity, boys and girls interacted differently					
When given choice time during an open activity, I reacted differently to boys and girls					
During meeting time, seat work, or teacher directed group activity time, boys and girls interacted differently					
During meeting time, seat work, or teacher directed group activity time, I reacted differently to boys and girls					
When freely choose peer-partners, girls and boys interacted differently					
When freely choose peer-partners, I reacted					

differently to girls and boys					
I believe my reactions can alter interactions with students					

Comments:

Reflection/Evaluation – Modules 2 and 3

Administrators and Guidance Counselors only please answer questions 1 and 2:

1. Please circle what type of educator you are currently:

   Administrator Guidance Counselor

2. Will today's session help you do your job better? (circle one)

Definitely	Probably	Maybe	Not likely	Not at all

Teachers only please answer question 3:

3. Will today's session bring more students into your classes? (circle one)

Definitely	Probably	Maybe	Not likely	Not at all

All educators please answer the following:

4. Will today's session help students? (circle one)

Definitely	Probably	Maybe	Not likely	Not at all

5. Name an "aha" moment that you had today.

6. Something I need to start doing is …

7. One question I have is …

8. More training in the following area(s) would be helpful:

Appendix B: Invitation Letter

Dear _____,

My name is Wendy Bibeau and I am a doctoral candidate at Walden University. I am conducting a doctoral study as part of the requirements of my EdD degree and I would like to invite you to participate.

I am studying educators' perspectives on female students' enrollment in CSE. If you decide to participate, you will be asked to meet with me for an interview regarding this topic. The interview will take place before or after school at a mutually agreed upon time and place and should last about 30 minutes. The interview will be audio taped so that I can accurately reflect on what is discussed. The tapes will only be reviewed by me. Following all interviews, a focus group will also be scheduled for all able to participate in that as well.

Participation is confidential and data collected will be kept secure. Taking part in the study is voluntary. You may decline to participate or withdraw from the study at any time without any repercussions.

Thank you for your consideration. I will be happy to answer any questions you may have about the study. If you would like to participate, please see me or respond to this e-mail when would be the best time for us to meet.

Thank you,

Wendy Bibeau
Wendy.bibeau@waldenu.edu

Appendix C: Informed Consent Form

You are invited to take part in a research study of Educators' Perspectives on Female Students' Enrollment in Computer Science and Engineering (CSE). The researcher is inviting educators who are, in some way, involved with students and CSE courses to be in the study. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Wendy Bibeau, who is a doctoral student at Walden University. You may already know the researcher as a teacher, but this study is separate from that role.

Background Information:
The purpose of this study is to gather information on the underrepresentation of girls in CSE courses and how teachers, administrators, and guidance counselors feel about this.

Procedures:
If you agree to be in this study, you will be asked to:

- Participate in an interview
- Participate in a focus group

Here are some sample questions:

- Do you believe there is an underrepresentation of girls in CSE courses here at this school?
- Do you think there is anything that can be done to increase the number of girls in CSE courses?
- Do you think there is anything that you personally can do to increase the number of girls in CSE courses?

Voluntary Nature of the Study:
This study is voluntary. Everyone will respect your decision of whether or not you choose to be in the study. No one will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind later. You may stop at any time.

Risks and Benefits of Being in the Study:
Being in this type of study involves some risk of the minor discomforts that can be encountered in daily life, such as being uncomfortable answering questions regarding

your thoughts on this matter. Being in this study would not pose risk to your safety or wellbeing.

This study's potential benefits include changes made in this school and others that encourage girls to participate in CSE courses, which then translates into more women in CSE careers.

Payment:
There will be no payment for participating in this study.

Privacy:
Any information you provide will be kept confidential. The researcher will not use your personal information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in the study reports. Data will be kept secure by keeping it in a locked cabinet. Data will be kept for a period of at least 5 years, as required by the university.

Contacts and Questions:
You may ask any questions you have now. Or if you have questions later, you may contact the researcher via wendy.bibeau@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is 04-17-13-0166707 and it expires on April 16, 2014**.**

The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By signing below, I understand that I am agreeing to the terms described above.

Printed Name of Participant

Date of consent

Participant's Signature

Researcher's Signature

Appendix D: Interview Protocol Form

Interview Protocol

I will be audio taping our conversation today. I will be the only one privy to the tapes, which will be eventually destroyed after they are transcribed. You must sign the Informed Consent Form, which states that all information will be held confidential and your participation is voluntary and you may stop at any time, for any reason. Thank you for your agreeing to participate.

I have planned this interview to last about 30 minutes. During this time, I have several questions that I would like to cover.

Introduction

You have been selected to participate in this study because you have been identified as someone who deals directly with students in computer science and engineering (CSE) courses or has an influence on these courses. My research project as a whole focuses on the underrepresentation of girls in CSE courses and how teachers, administrators, and guidance counselors feel about this. This study is not judging anyone's performance but rather trying to learn more about how educators feel about the underrepresentation of girls in CSE.

Interviewee Background

- Are you male or female?
- Are you currently a teacher, administrator, or guidance counselor?
- How long have you been at this school?
- Have you thought about the underrepresentation of girls in CSE courses before being approached for this study?
- Do you believe there is an underrepresentation of girls CSE courses here at this school?
    - Why or why not?
- Do you believe there is a shortage of women in CSE careers?
    - Why or why not?
- Describe any strategy in place right now or in the past to create interest in CSE courses?

  - Does/did this strategy specifically try to increase girls' interest?
- Do you think there is anything that can be done to increase the number of girls in CSE courses?
  - If so, what are those changes?
    - Who would be directly responsible for this change?
  - If not, why not?
- Do you think there is anything that you personally can do to increase the number of girls in CSE courses?
  - If so, what specifically would those changes look like?
  - If not, why not?
- What types of changes could be made at the teacher level to increase female interest in CSE courses?
  - What types of barriers would this have?
  - What types of benefits would this have?
- What types of changes could be made at the guidance counselor level to increase female interest in CSE courses?
  - What types of barriers would this have?
  - What types of benefits would this have?
- What types of changes could be made at the administration level to increase female interest in CSE courses?
  - What types of barriers would this have?
  - What types of benefits would this have?
- Is there anything else you would like comment on this topic before we end the interview?

Appendix E: Focus Group Protocol Form

Focus Group Protocol

I will be audio taping our conversation today. I will be the only one privy to the tapes, which will be eventually destroyed after they are transcribed. You have already signed the Informed Consent Form, which states that all information will be held confidential, your participation is voluntary and you may stop at any time, for any reason. Thank you for agreeing to participate.

I have planned this focus group session to last about 1 hour. During this time, I have several questions that I would like to cover.

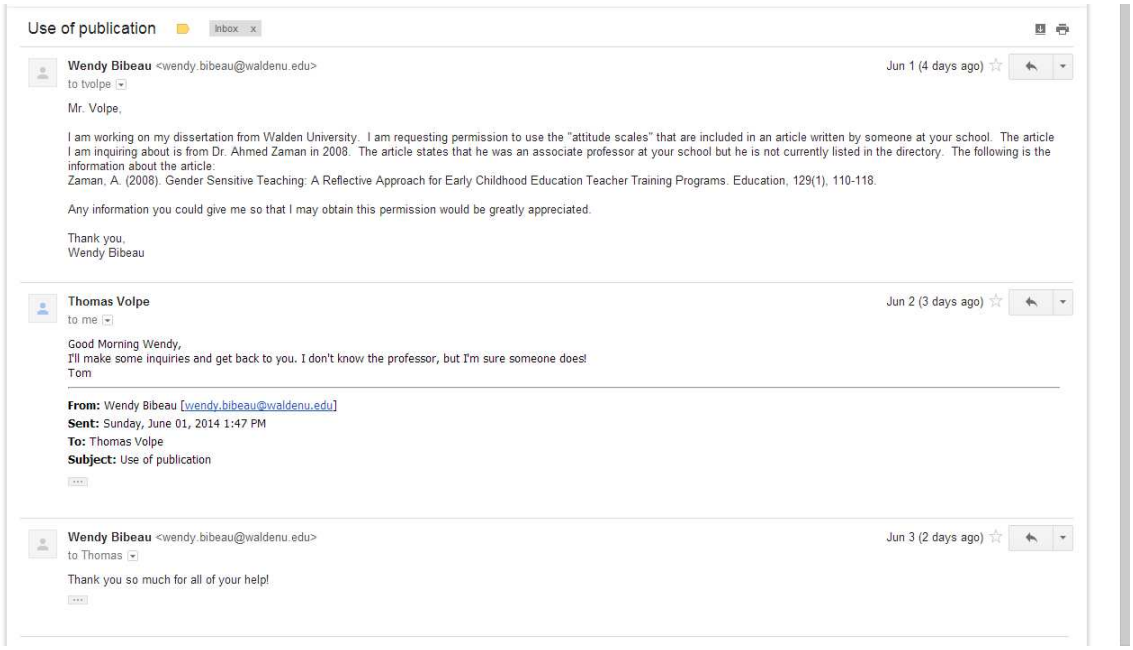
Introduction

This is a follow up to the interview you have all had individually. We are now coming together as a group to discuss what your thoughts are now that you have had some time to think about your interview. All of you were selected to participate in this study because you deal directly with students in computer science and engineering (CSE) courses or you have an influence on these courses. Teachers deal directly with students and the CSE curriculum, guidance counselors speak and make recommendations to students regarding course selection, and administration takes the lead and makes final decisions with school-wide curriculum. My research project focuses on the underrepresentation of girls in CSE courses and how teachers, administrators, and guidance counselors feel about this.

Focus Group Questions to Start Discussion

- Have you thought more about the underrepresentation of girls in CSE courses since your interview?
    - If so, have you changed your mind regarding your initial thoughts?
    - Why or why not?
- Have you done any research on this after your interview?
    - If so, what were your findings?
- As a group, let's brainstorm ideas about what can be done to increase the number of girls in CSE courses.
    - Who would be responsible to start these changes?
    - How much would these changes benefit the girls in our school?
    - How willing are you personally to implement these changes?
- Is there anything else you would like talk about before we end the focus group session?

Appendix F: Permissions



Use of publication Inbox x

Wendy Bibeau <wendy.bibeau@waldenu.edu> Jun 1 (4 days ago)
to tvolpe

Mr. Volpe,

I am working on my dissertation from Walden University. I am requesting permission to use the "attitude scales" that are included in an article written by someone at your school. The article I am inquiring about is from Dr. Ahmed Zaman in 2008. The article states that he was an associate professor at your school but he is not currently listed in the directory. The following is the information about the article:
Zaman, A. (2008). Gender Sensitive Teaching: A Reflective Approach for Early Childhood Education Teacher Training Programs. Education, 129(1), 110-118.

Any information you could give me so that I may obtain this permission would be greatly appreciated.

Thank you,
Wendy Bibeau

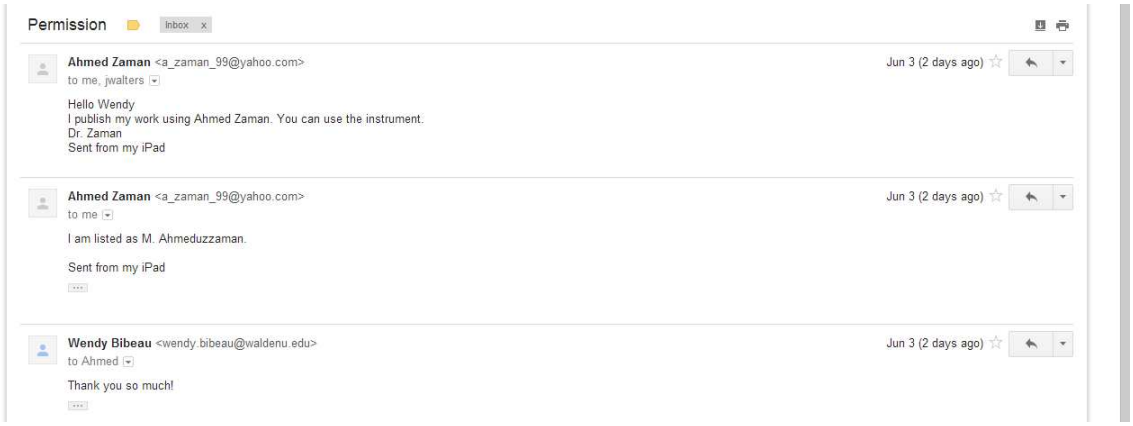
Thomas Volpe Jun 2 (3 days ago)
to me

Good Morning Wendy,
I'll make some inquiries and get back to you. I don't know the professor, but I'm sure someone does!
Tom

From: Wendy Bibeau [wendy.bibeau@waldenu.edu]
Sent: Sunday, June 01, 2014 1:47 PM
To: Thomas Volpe
Subject: Use of publication

Wendy Bibeau <wendy.bibeau@waldenu.edu> Jun 3 (2 days ago)
to Thomas

Thank you so much for all of your help!



Permission Inbox x

Ahmed Zaman <a_zaman_99@yahoo.com> Jun 3 (2 days ago)
to me, jwalters

Hello Wendy
I publish my work using Ahmed Zaman. You can use the instrument.
Dr. Zaman
Sent from my iPad

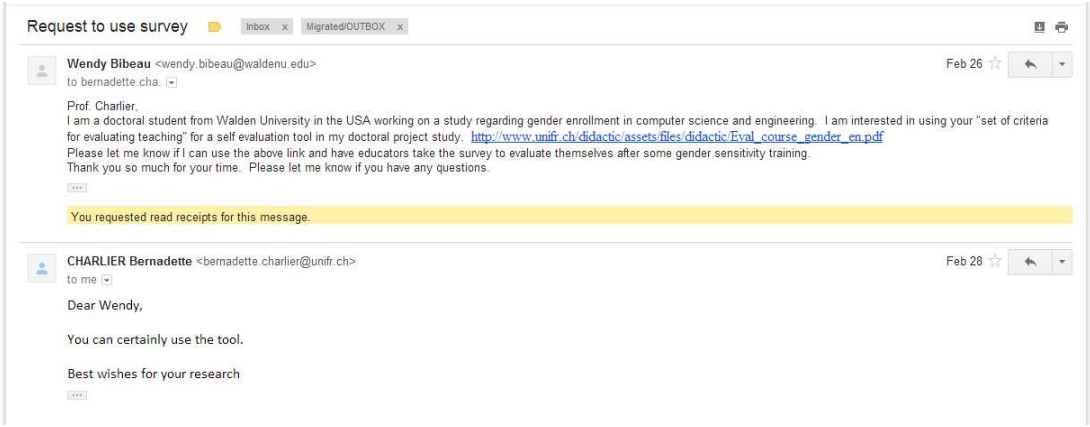
Ahmed Zaman <a_zaman_99@yahoo.com> Jun 3 (2 days ago)
to me

I am listed as M. Ahmeduzzaman.

Sent from my iPad

Wendy Bibeau <wendy.bibeau@waldenu.edu> Jun 3 (2 days ago)
to Ahmed

Thank you so much!



Request to use survey

Inbox x Migrated/OUTBOX x

Wendy Bibeau <wendy.bibeau@waldenu.edu> Feb 26

to bernadette.cha.

Prof. Charlier,
I am a doctoral student from Walden University in the USA working on a study regarding gender enrollment in computer science and engineering. I am interested in using your "set of criteria for evaluating teaching" for a self evaluation tool in my doctoral project study. http://www.unifr.ch/didactic/assets/files/didactic/Eval_course_gender_en.pdf
Please let me know if I can use the above link and have educators take the survey to evaluate themselves after some gender sensitivity training.
Thank you so much for your time. Please let me know if you have any questions.

You requested read receipts for this message.

CHARLIER Bernadette <bernadette.charlier@unifr.ch> Feb 28

to me

Dear Wendy,

You can certainly use the tool.

Best wishes for your research

Curriculum Vitae

WENDY G. BIBEAU

EDUCATION

Certified Experienced Comprehensive Business Educator

Expected Completion 2014 — *Walden University* — Minneapolis, MN
Doctorate in Education
Concentration in Administration Leadership for Teaching and Learning
Project Study: Educators' Perspectives on Female Students' Enrollment in Computer Science and Engineering

1995 — *New Hampshire College* — Manchester, NH
Master of Science in Business Education

1991 — *University of Lowell* — Lowell, MA
Bachelor of Science in Business Administration
Concentration in Management Information Systems
Computer Proficiency Certificate

2005 — Certified Microsoft Office Specialist Master (Word, Excel, Access, & PowerPoint)

EMPLOYMENT

9/08–Present
Business Teacher
- Teach Computer Applications, Web Design, Desktop Publishing, Web 2.0 courses
- Serve on District Technology, Technology Education, and UbD committees
- Teach adult education for Microsoft Office and Excel classes
- Team teach professional development technology sessions to faculty
- Mentor to new teachers
- Advisor to National Business Honor Society

5/05–12/08 *Southern New Hampshire University* — Portsmouth and Manchester, NH
9/01–2/02 **IT Instructor**
- Taught Intro to Computer Technology courses

8/94–6/08 *Hesser College* — Manchester, NH
Business Instructor

- Taught courses such as Office Systems Management, Desktop Publishing, Production Typing, Word I & II, Publisher, PowerPoint, Excel, Access, Intro to Computer Technology
- Technology liaison between adjunct faculty and technology department at main campus

9/00–6/06 *Northern Essex Community College* Haverhill, MA
Computer Instructor
- Taught non-credit courses such as Intro to PCs and Windows and various MS Office courses including preparation courses for Microsoft Office certification

9/00–6/04 *Senior Friends* Portsmouth, NH
Computer Instructor
- Taught basic computer courses including Windows and MS Office to Senior Citizens

11/99–6/00 *American Training, Inc.* Lawrence, MA
Computer Skills Instructor
- Taught Keyboarding, Office Procedures, Data Entry, Windows, MS Word, Excel

3/99–11/99 *Computer Learning Centers, Inc.* Methuen, MA
Instructor
- Taught MS Office, Internet, E-Mail, Web Pages, Intro to Computers, and DOS

1/95–6/98 *Computer-Ed Business Institute* Woburn, MA
School Director (6/96 – 6/98)
- Managed day and night school
- Attended Accreditation Workshops (ACICS)
- Helped prepare Woburn campus to receive initial accreditation

Instructor (1/95 – 6/98)
- Facilitated many software courses including: keyboarding, word processing, spreadsheets, databases, presentation, graphics, desktop publishing, accounting, & medical software
- Lectured courses such as DOS, Windows, Utilities & Troubleshooting
- Occasional floating instructor for one-day seminars such as Lotus Notes

8/93-6/94 *R & R Consultants, Inc.* Canton, MA
Computer Teacher
- Taught various Apple programs to grades 1 through 6 including: Typing, Desktop Publishing, Database, and Logo Programming