Journal for the Advancement of Educational Research (2016), vol. 10(1)

Closing the Gender Gap in Education: Making a Difference in Math and Science Classrooms

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Abstract

This study presents research that was conducted in the Sandhills Region of North Carolina. In particular, the study involves focus group questionnaires that were distributed to two high schools within the Sandhills Region. The primary objective of the study is to establish an understanding of the difference between male students' and female students' perceptions of Science, Technology, Engineering, and Mathematics (STEM) courses and career pathways, as this will provide further evidence to suggest how educational leaders, teachers, and university teacher-education programs can work toward closing the gender gap in education. The literature review and results sections will provide substantive evidence to suggest that progress is being made in the way of closing the gender gap, but this process remains ongoing in the twenty-first century.

Introduction

Closing the gender gap in PK-12 education has been a topic of consideration for decades. In fact, Hyde, Lindberg, Linn, Ellis, and Williams (2008) note the following: "Stereotypes that girls and women lack mathematical ability persist and are widely held by parents and teachers" (p. 494). In essence, what this implies is that gender-based stereotypes are, in part, why females have previously not been encouraged to take Science, Technology, Engineering, and Mathematics (STEM) classes or engage in STEM projects, majors, and career fields. Likewise, consideration must be given to the reasons why males are more likely to pursue the STEM classes, as boys typically need more hands-on activities, which are common in STEM classes. If the schools are limited on STEM courses, the schools may seem to be more geared toward female students because of the structure to sit quietly like sponges, merely absorbing what the teacher delivers. In an effort to determine factors that contribute to the gender gap among males and females within the STEM content areas, the researchers of this study developed focus group questions that prompt the students to provide substantive responses about their perceptions of a variety of topics involving

STEM.

Purpose and Objectives

This study examines secondary school students' perspectives of subjects in high schools, to include STEM courses. This study uses focus group questionnaires to gain insight into the courses that high school students deem engaging and appealing. The study further considers the students' first introduction to STEM courses, as well as the students' past and present attitudes toward STEM courses.

Literature Review

A cursory search of literature reveals that several previous studies have determined that males are outperforming females in the math and science classes within the PK-12 setting; however, more recent literature reveals that females are actually outperforming males in math and science classes within the PK-12 setting. The 2011 National Assessment of Educational Progress (NAEP) actually reveals that among eighth grade male and female students, there is no significant change in the gender gap, but both genders did experience growth in scores. As both genders experienced increased scores, consideration must be given to the notion that "studies, articles, and expert opinions point to the same issues that perpetuate the gender gap in STEM: a lack of female STEM role models, deeply ingrained cultural biases and gender stereotypes, and pop-culture portrayals and societal attitudes…" (Kehl, 2013). To apply Kehl's reasoning to the fact that both genders increased scores in STEM classes at the eighth grade level, consideration must be given to point at which females are shying away from STEM programs of study and career fields.

One particular reason why females are less apt to pursue STEM fields is gender stereotyping. In fact, Hyde et al. (2008) note the following: "Stereotypes that girls and women lack mathematical ability persist and are widely held by parents and teachers" (p. 494). The implication of such a striking fact is that gender-based stereotypes are, in part, why females have previously not been encouraged to take STEM classes or engage in STEM projects, majors, and career fields. Additionally, Hyde et al. (2008) further that "Gender differences in mathematics performance and ability remain a concern as scientists seek to address the under-representation of women at the highest levels of mathematics, the physical sciences, and engineering" (p. 494). Thus, experts and educators are concerned about the disparity between males and females in STEM, as there are growing concerns about how to increase continued interest in STEM courses as females matriculate through their academic years.

Whitmire and Bailey (2010) explain that over the past 20 years, "discussions of gender equity have fallen into an either/or paradigm in which one group of students has been singled out as the only group needing attention," and although females in STEM tends to be one of the trending topics among researchers and educators, continued research on males in English Language Arts courses should also be of concern. Research indicates that "When you examine state tests…you see that girls have scored even with boys in math and science. In some cases, they outscored boys in those subjects" (Whitmire & Bailey, 2010). However, little evidence suggests that boys are scoring equal to girls in reading and writing, or English Language Arts, courses. Instead, despite the fact that girls are performing alongside the boys in the sciences and mathematics courses, Lichtman (2013) asserts that a report by the American Association of University Women explains: "Well, among college grads, men outnumber women in nearly every science and engineering major." Lichtman (2013) questions why there is not an increase of women in the science

workforce if more females are taking science in school. The literature questions how encouraged females are to pursue occupations in STEM Robelen (2014) notes that "gender divides are still apparent, especially with participation in the STEM fields of science, technology, engineering, and mathematics." Robelen (2014) states that "Recent federal data show just one-quarter of people working in those fields are women; one in seven engineers is female."

In consideration of Robelen's previously mentioned statement, thoughtful consideration should also be given to Harvard University's study conducted by Ganguli, Hausmann, and Viarengo (2011) in which the researchers explain: "Evidence has shown that educating women can lead to improved economic and social outcomes. Specifically, recent empirical work…shows that there are both positive economic consequences and social externalities arising from improving women's education" (p. 3). Essentially, this implies that when women are encouraged to pursue academic programs of study in fields that equate to higher salaries, or the STEM fields, the economy improves holistically. Though Jacob (2002) asserts that in the twenty-first century, about 60 percent of the college population is comprised of females, the females must be encouraged at a young age to pursue the STEM courses that will eventually lead to pursuing college degrees in STEM programs of study. In turn, the females will then seek careers in the STEM occupations, which will likely improve the economy. However, in order for such an effect to transpire, Kohn (2002) suggests that educators and stakeholders understand that the gender gap is not happening in inner cities; instead, the gap is "happening in all segments of society, in all 50 states." As girls are actually "dominat[ing] the landscape academically right now," to include math and science courses and honors' societies (Kohn, 2002), educators, parents, and stakeholders have a responsibility to encourage girls to continue this path of success without trepidation and fear—or discouragement because of age-old mentalities.

Methods

A qualitative approached was used to gather the data in an attempt to gain insight and develop generalizations about closing the gender gap in math and sciences education. The researchers used questionnaires to gather students' responses. In order to gather the data, the researchers engaged in a systematic study of males and females at two rural high schools in North Carolina. The researchers physically went into the schools and met with administrators prior to conducting the study. After meeting with administrators, the researchers distributed the questionnaires to the teachers who, in turn, prompted students to complete the questionnaires. The only demographic information that students were asked to provide was their self-identified gender. The researchers returned to the schools one week later to collect the data. After all of the data were gathered, sorted and analyzed the results were focused on common recurring themes in the students' responses. The questions that guided this study were as follows:

What subject is your favorite? What about this subject do you enjoy?

Are you aware of the acronym STEM? What is your attitude toward STEM (Science, Technology, Engineering, and Mathematics) classes?

Rank the importance of science, technology, engineering, and math. Do you enjoy English or social studies courses better than math or science, why or why not?

What would you suggest teachers do to make STEM courses more engaging and interesting to students?

What is your career intention? Have you considered a career in a STEM field?

Why or why not?

Were you introduced to the STEM fields in elementary, middle, or high school? What is your earliest memory of a STEM content area?

Did you once have an interest in the STEM content areas at an early age, such as elementary school, but lost interest as you matriculated, or progressed, through the grade levels?

What is your impression of the teachers' attitudes toward boys and girls in STEM courses? Have you been discouraged or encouraged to pursue an interest or career in STEM by your teachers, if so how?

Has your family encouraged you to pursue a role in a STEM field? What particular role has been encouraged (e.g. engineering, biology)?

Do you think that you will get into a good college and major in an area needed for a career in science, technology, engineering, or math, why or why not?

Participants

839 Students from two rural high schools in the Sandhills Region of North Carolina participated in the study. One high school, coded School A, is in the Hoke County school district. The other high school, coded School B, is in the Cumberland County school district. From School A, 90 self-identified females and 91 self-identified males participated in the study. From School B, 312 self-identified females and 338 self-identified males participated in the study. Thus, the total number of participants in this study is 182 from School A and 657 from School B. The participants ranged from freshman through senior levels.

Results

Focus Question 1

Students were asked to identify their favorite subject. Students' responses are indicated on Figures 1 and 2, and although the figures do not depict why the students chose such subjects, students cited various reasons why the subjects were their favorites. Some students contended that the subjects were easy; other students explained that a certain teacher or homework load swayed the student responses, and students appreciated the hands-on aspect of science classes.

Table 1. Results to indicate female students' favorite subjects.

	English	Math	Science	Arts	History	Phys. Ed.
School A Females	20	20	21	11	9	0
School B Females	78	50	79	39	41	11

Table 2. Results to indicate male students' favorite subjects.

	English	Math	Science	Arts	History	Phys. Ed.
School A Males	9	26	36	5	11	7
School B Males	32	63	85	8	59	48

Focus Question 2

Students were asked if they were aware of the acronym STEM and what their particular attitude was toward STEM classes. In response, students at both School A and B were confused in regards to the acronym. Some students thought it directly related to an anatomy course about males and females,

while other students simply responded "no" in that the students were not aware of the acronym. An explanation of STEM was indicated- science, technology, engineering, and mathematics; however, the majority of students explain that they have no concept of such a program. For instance, one student states that he is aware of the STEM classes, but "they appear to be just like any other classes." In essence, one might consider that educators in the secondary setting have not explained that science; technology, engineering, and math courses are, in fact, STEM courses.

Focus Question 3

This question asked students to rank the importance of science, technology, engineering, and math; it also asked students if they enjoyed English or social studies courses better than math or science. At School B, the majority of females responded with surprising remarks that science classes were the most important, but instead of following science with technology, engineering, or math, the females actually stated English was a close second to science courses. About one quarter of the female students at School B remarked that all of the courses were essential to learning and growth, but, once again, science and English were the predominant responses. Of the males at School B, math ranked highest, with engineering and technology as the second most common in terms of level of importance. Overall, science was ranked fourth for the majority of males, but some males ranked science as the most important. Of the male students, only seven remarked that English was the most important. At School A, males ranked math as the highest, as well, but science was the most prevalent responses for the second highest in importance. Following math and science were engineering and technology. Once again, about one quarter of the students claimed that English was more important than at least one of the STEM content areas. Moreover, many males contended that English was more important than science; therefore, if science was ranked second, it is noteworthy to mention that many male students at School A believe math and English are the two most important content areas, followed by science, engineering, and technology.

Focus Question 4

Students were encouraged to suggest what teachers could do to make STEM courses more engaging and interesting. The students are the individuals who make the decision to take STEM courses, thus educators must develop an understanding of how to develop attitudes and curriculums that promote more engaging and interesting STEM courses to both males and females. To this question, numerous male and female students, alike, discussed that being "more active"; "more interactive activities"; and, "having hands on activities" would provide for a more engaging and interesting STEM course. In fact, having hands-on activities was a primary response because students clearly want to be a part of the learning experience. To that, one female student discussed that teachers should find more interesting ways to teach the material so that the students can remember the information. Retention, thus, is a factor in female students' decisions to take or not to take STEM courses.

Focus Question 5

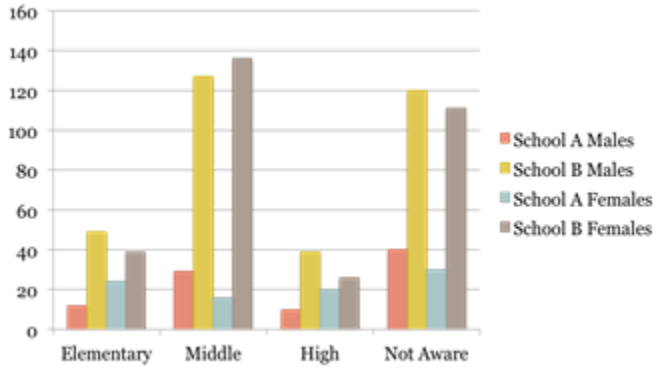
This question asks students' career intentions and whether or not they have considered a career in a STEM field. One student acknowledged that he wanted to become a dentist but had no intention of going into a STEM field. Two male students discussed becoming doctors without entering into a STEM field. In consideration of female

students, one female stated "I want to be a psychologist so it is in the STEM." Another female stated: "All jobs require at least a little STEM knowledge." Very few females, even those who were not interested in STEM fields, had difficulty making the connection between certain careers and STEM fields; whereas, the males appear to be interested in STEM fields but had little knowledge that the fields provided were, indeed, STEM-related.

Focus Question 6

This question asked students if they were introduced to the STEM fields in elementary, middle, or high school. Figure 1 indicates the results of this focus question.

Figure 1.
Results to indicate student's earliest memory of STEM coursework in school.



Focus Question 7

When asked if lost interest through matriculation, almost half of the female participants at School A simply said that they did not lose interest. Meanwhile, the remaining half stated that they did lose interest because the courses relating to science and math became too difficult. One student even replied: "I wanted to be a doctor, but someone told me it was too hard to do because of the math and science." In essence, this particular female lost interest in STEM simply because someone told her that she would not succeed in a STEM field. Once again, this directly relates to the stereotype of females in STEM. As for the male respondents, over half of the males at School A and three-quarters of the males at School B said that they once had an interest in STEM, but of that portion of respondents, only seven males said they lost interest over the course of time. Perhaps this striking fact lends one to grasp the ways in which male students are mentored in the areas of STEM, as opposed to how female students are not mentored in the areas of STEM.

Focus Question 8

The concentration was focused on the students' impression of teachers' attitudes toward boys and girls in STEM courses. The question posed was if students have ever been discouraged or encouraged to pursue an interest or career in STEM. In response to this question, females at both schools had distinctive responses as compared to male students. The majority of responses allude to the notion of being discouraged; however, male respondents typically included the caveat that despite being discouraged, they would continue to pursue the STEM field. The females who further elaborated on being discouraged, on the other hand, explained that as a result of being discouraged, they stopped pursuing STEM courses. One female from School A stated that "I have been discouraged [because] of the attitude of the teacher." Another female said that males and

females were treated the same in her classes and also boldly stated the following of encouragement: "I have been encouraged by one of my teachers because he showed me a few jobs I thought were cool that used STEM." A female student at School B claims: "All of my teachers treat everybody equal, but no it wasn't them [the teachers] who encouraged me. It was my mom." Once again, the student is neither receiving encouragement nor discouragement from the educators; instead, the female has a mother who is urging her daughter to take STEM courses and pursue a career in STEM.

Some females noted that they had not been discouraged or encouraged, but no further evidence was provided on what the teachers could do to encourage the females. One female from School A did note that "Guys are more dilatory, and girls aren't." It is also noteworthy to consider that if this is the female student's perception of males in STEM classes, females, thus, are more active and engaged in STEM classrooms. Furthermore, one female from School B notes that she has been encouraged but prefers not to pursue a career in a STEM field. In one of her previous responses, she notes that English is her favorite aspect of her high school education.

Focus Question 9

Though some students discussed their familial influences, question nine posed the question, "Has your family encouraged you to pursue a role in a STEM field? What particular role has been encouraged (e.g. engineering, biology)?" 36 females at School A and 122 females at School B stated their families did encourage a STEM field. Of the responses, many females said a medical field, namely doctor, nurse, or pharmacology. The majority of males at both, School A and School B simply stated they were not encouraged, and many stated that their families encouraged law enforcement or the military. As this school is in the Sandhills Region of North Carolina, which is directly outside of the Fort Bragg Military Installation, such a response seems logical and appropriate, especially if the parents are not sure of other known career fields in this region. A small portion noted engineering; math was not mentioned.

Focus Question 10

Focus question ten asks: "Do you think that you will get into a good college and major in an area needed for a career in science, technology, engineering, or math, why or why not?" 76.9% of females indicated yes they will get into a good college and major in an area needed for a career in science, technology, engineering, or math; 11.8% of females said no; and, 11.3% said they were not sure or were undecided. Meanwhile, only 54% of males said yes they will get into a good college and major in an area needed for a career in science, technology, engineering, or math; 27% of males said no; and, 19% said they were not sure or were undecided. These percentages indicate the totals for both School A and B. What these results yield is that females appear to be more aware of the direction in which their academic careers will go. Educators must capitalize on that fact and encourage females to pursue STEM courses and careers in STEM fields.

Discussion

Several commonalities persisted among students' responses to the focus group questions. Perhaps of most importance is the need to be cognizant of the fact that if students are not being told about the acronym STEM and what it means, students will not be aware of their own personal interests in STEM fields. Another point of consideration is that females are as likely to be interested in STEM content areas throughout the secondary academic years; however, in order

to debunk the misconceptions and stereotypes of women in STEM fields, K-12 institutions must continue to reinforce the value of females taking science, technology, engineering, and math courses throughout the high school years.

Limitations and Suggestions for Future Research

Several limitations of this study should be considered. In particular, this study is only qualitative in nature and does not include the specific quantitative data to determine how males and females at these two schools are performing in STEM courses. Another limitation of the study is that the teachers provided the questionnaires to the students, thus the researchers were not able to encourage the students to provide substantive responses. For future research studies, it is recommended that the researchers engage in dialogue with the focus groups and verbally discuss the questions in depth with the students. Most importantly, the researchers suggest drawing data-based correlations between the students' responses and the students' actual performance in STEM content areas in hopes of better student outcomes in the field of science, technology engineering and mathematics.

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