Information Sheet: Gender Differences in Math Performance

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Mr. Smith is a 10th grade mathematics teacher who has been teaching for several years. Given the attention that student performance on standardized assessments has received in his school division Mr. Smith devotes a fair amount of class time to preparing the students in his class to successfully address the content included on mathematical achievement tests. Despite the attention that he gives to this school-based initiative, the male students seem to perform better than their female peers. Mr. Smith is not surprised by this trend as his experience has been that the females seem to be less engaged in the class competitions and drills that are part of his lesson plans. These same female students don't seem to readily identify that they have an interest in pursuing careers that require application of math subject matter.

Females have demonstrated that they are equally capable of learning and mastering mathematical concepts and knowledge as their male counterparts (Meinholdt & Murray, 1999). However, results of standardized assessments measuring math performance by gender are mixed. In some specific mathematical content areas males outperform female peers (Mullis, Martin, & Foy, 2008). In other instances, females complete comparable levels of mathematics coursework as their male peers (Ingels & Dalton, 2008) and attain degrees in mathematics at rates similar to males. Further insights are provided by examining statistical trends related to gender differences in math performance in relation to studies that identify environmental factors that influence the motivation and performance of females related to math achievement (Kiefer & Sekaquaptewa, 2007; Thompson & Dinnel, 2007).

This information sheet provides a summary of key points related to trends in math performance by gender and discusses how this research can be utilized by instructional professionals in K-16 who are involved in science, technology, engineering, and math (STEM) disciplines. More detail with regard to differences in math performance by gender is reviewed in the Gender Differences in Math Performance Literature Overview.

Brief Overview of Research Related to Statistical Trends:

- Results from multiple standardized assessments reveal that math performance has increased nationally among K-12 students with average scores increasing across grade levels. Males and females are completing more advanced coursework in mathematics including pre-calculus and calculus which are identified as important courses for students that aspire to attain a degree in STEM fields (Ingels & Dalton, 2008; United States Department of Education, 2004). In addition, males and females are completing a roughly equal number of average credits in mathematics by the time of high school graduation (Dalton, Ingels, Downing, & Bozick, 2007).

- Despite comparable academic preparation and within classroom performance, males continue to outperform females at the elementary, middle, and high school levels on standardized tools

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measuring math performance (Mullis, Martin, & Foy, 2008; United States Department of Education, 2004).

- Among elementary school students and middle school students, males scored higher on average than females in the mathematics content areas of numbers and operations, measurement, and algebra; while female students scored higher in geometry (National Assessment of Educational Progress [NAEP], 2007). Among 2007 high school graduates, males tended to score higher on Advanced Placement mathematics tests in calculus and the math portion of the SAT. Fewer female than male high school graduates demonstrated readiness for college-level coursework that requires application of mathematical skills as measured by the American College Test (ACT) (*ACT High School Profile Report: HS Graduating Class*, 2007).

- Roughly equal proportions of females and males earn a bachelor's degree in mathematics or statistics (National Science Foundation, 2008). However, there is a significant disparity when considering female degree attainment in fields that require application of mathematical skills such as engineering (National Science Foundation, 2008).

Impact and Application of Research for Practitioners

Research has sought to identify plausible explanations for differences in math performance between males and females. Environmental factors rather than differences in math ability by gender have been shown to have a primary influence on math performance among females. These factors fall into four general categories including, experiences that shape students' attitudes towards math, encountering negative gender-based stereotypes related to female interest in math, lack of appropriate role models in math related careers, and lack of knowledge about careers that utilize math skills. Research has highlighted actions and interventions that can be undertaken to counter these factors and encourage female math achievement.

- Shaping students' attitudes towards math: Students with positive attitudes towards math are more likely to perform better on mathematical assessments. Given studies that show males are more likely to indicate positive perceptions towards math and math-related subject matter, practitioners should consider how they teach math and whether they are shaping classroom experiences for both males and females so that both groups respond to math favorably (Gonzales et al., 2004). For instance, competitive environments have been shown to deter females from developing math skills and knowledge (Kiefer & Sekaquaptewa, 2007; Thompson & Dinnel, 2007), while collaborative educational experiences that utilize group work may impact the math performance of females favorably (Thompson & Dinnel, 2007). Instructors can monitor group work so that both males and females have the opportunity to complete complex tasks, serve in leadership roles, and apply subjects through hands-on application.

- Working to counter negative stereotypes: Female performance in mathematics classes may be negatively impacted due to gender-based stereotypes held by instructional professionals (American Association of University Women, 1992). Professionals may more often interact with or provide feedback to male students in mathematics classrooms, negatively impacting the confidence of female students related to math performance. Stereotypes may also undermine the confidence of female students themselves, creating anxiety about math performance. This

leads to fear of failure and possible disengagement from math-related subject matter (Kiefer & Sekaquaptewa, 2007; Thompson & Dinnel, 2007). Instructional professionals can also work to boost the confidence of female students by providing positive feedback along with constructive criticism where appropriate. Schools should also consider professional development activities for instructional professionals that explicitly address these issues. Such activities have been shown to have favorable results when implemented within educational settings. Finally, influential individuals such as parents who hold gender-based stereotypes may discourage females from pursuing careers in math or related STEM fields (Davis-Kean, 2007). To correct this, schools may want to consider math forums for parents, which have been used in some school districts to encourage parents to take an active role in their child's math performance (Cavanagh, 2009).

- Providing appropriate role models: Lack of appropriate role models in STEM fields may also have a negative effect on female interest in STEM careers. Mentoring programs that pair female students with female role models can show aspiring engineers that it is possible to have a successful career in STEM fields. This may also serve to provide female students with viewpoints different from those held by their parents, which in some instances may be gender-biased.

- Recruiting women into STEM careers: Gender-based stereotypes that female students and parents may hold with regard to the nature of work done in STEM disciplines and the preparation that is needed should be addressed at multiple levels. This includes raising these points at formal and informal recruitment activities for STEM majors or careers and within the math curriculum in educational settings. Work done in this area has shown that clarifying what kinds of work engineers do helps mitigate stereotypical views that STEM careers are better suited to males (Cunningham, 2007).

Recommendations for Action

- Given the trends that show differences in math performance between males and females begin appearing early, practitioners should implement strategies to increase self-confidence in math early on in instructional experiences rather than waiting until high school when many females may have already decided to pursue careers in fields outside of STEM.

- Using a variety of pedagogical strategies that address different learning styles within instructional environments has been shown to encourage student achievement in mathematics classrooms, particularly among females. For instance, strategies such as collaborative learning, instruction in small-group settings, inquiry-based approaches, and hands-on activities have been shown to be effective in teaching math and science and benefits female as well as male students (Clewell, Anderson, & Thorpe, 1992). Alternative forms of assessment, such as demonstrating steps that go into problem-solving and explaining how students derived certain answers, can provide an alternative means to feedback. This method can also highlight different skills and abilities related to math, boosting confidence and subsequently math performance among diverse groups of students.

- Additional research can be done in the following areas to explore gender differences in math performance further. Future studies could examine specifically what math skills are needed for

success in science, engineering, and technology. Researchers could then determine whether those skills are being taught to as well as mastered and applied by females at the same rate as their male counterparts as part of in-class as well as out-of-class experiences. Studies could also examine specifically which skills national assessments measure and whether females receive the same amount of exposure to those skills in classroom settings as well as outside of class. The career goals of female students who enroll in advanced mathematics courses in K-12 and at the undergraduate level could be examined further to determine the degree to which career aspirations and perceived work-life balance issues associated with STEM careers influence performance. Finally, the national assessments used to gauge trends in math performance by gender could be examined more closely to explore whether they are biased given the fact males out-perform females yet females complete comparable coursework in many instances.

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