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Same Performance but Different Perception: Female Stereotypes in Mathematics Emerge in Fifth Grade

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ABSTRACT

Prior study on the differences in the performance levels of male and female students in elementary and middle school mathematics show mixed results. While significant differences are reported in some studies, others show no such differences. This study assessed differences that might exist in the performance levels (self-reported grades) and beliefs of male and female students in mathematics. One-hundred and twenty-nine (129) students, sixty-seven (67) female and sixty-two (62) male, completed survey questions ranging from fourth through seventh grade. There was no significant difference in the performance level of male and female students; however, whereas male students felt more successful and labeled mathematics as one of their best subjects, their female peers largely reported the contrary. Stereotypes were found to have started in fifth grade and widen up to seventh grade.

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Mathematics, Female Students, Stereotypes, Elementary School, Middle School

Intoduction

A global reality is prevalent in that the numbers of females in Science Technology Engineering and Mathematics (STEM) fields are low compared to males (Hill, Corbett, & St Rose, 2010). Several studies and propositions have been made in an effort to address this problem and to encourage women to pursue STEM subjects (Griffith, 2010). Unfortunately, most recent publications from around the world reveal that the problem persists (Ceci & Williams, 2011). If researchers can identify what causes fewer women to go in to STEM fields, then they can seek solutions.

The purpose of this study is to investigate if differences exist in the performance level of male and female students in mathematics at the elementary and middle school level, and if there is any difference in the way male and female students view mathematics. We also want to find out when stereotypes begin to manifest in female students, if they exist at all. Researchers argue that it is at this level that girls' attitudes, interests, and ideas about the different subjects that they study are formed (Muzzatti & Agnoli, 2007). Such knowledge will aid teachers and educational planners in knowing where effort should be concentrated in combating these negative traits in girls and by so doing, the population of those going in to mathematics might increase.

Girls have been at a disadvantage in most parts of the world and they continue to be, even today (Jha & Kelleher, 2006). The notion that women are weak in certain tasks is reflected in the unequal participation of female students in mathematics and sciences, as compared to men (Hill, Corbett & St Rose, 2010). The

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numbers of females who take advanced mathematics courses are fewer than males (Eccles, 2007), and the females who continue with mathematics are fewer yet (Blickenstaff, 2005).

A plethora of research findings on gender differences in mathematics have revealed that stereotypical/cultural beliefs are the main factors accounting for the underrepresentation of females in mathematics. In the past, stereotypical beliefs appear to be the dominant factor that explains why women tend to shy away from mathematics and sciences at large. In her study on factors that keep women away from the sciences, Rosser (1989) found that women often believe that mathematics is cold and void of intuition and creativity. The majority of the women involved in the study believed that mathematics is learned by memorization and by having what they referred to as a *mathematical mind*. Rosser found that such beliefs interfered with girls' understanding and confidence in their ability to understand mathematics.

Simon (2000) also reported on stereotypical beliefs, leading to women's exclusion from mathematics and the sciences in general. Simon reported that, such gender beliefs were held even by ancient fathers of mathematics, such as Pythagoras (600 B.C.E). Pythagoras believed that numbers belonged to the psychic domain, which to him was masculine. According to Pythagoras, the female cranium was too small to hold a powerful brain, which could handle numbers or mathematics. He even believed that intercourse between a man and a woman robbed men of their mental potential in terms of critical reasoning.

As late as the 19th century C.E., beliefs still loomed that women's brains were too weak to sustain rigorous theory. Recently, the president of Harvard University suggested at a scholarly meeting, "one reason fewer women make it to the top in mathematics and science may be because of innate differences of ability from men" (Fogg, 2005). However Şengül and Gülbağcı (2012) found no correlation between the gender of students and their number intellects.

Glover (2002) argues in her book *Women and Scientific Employment* that stereotypes are the leading factors explaining why most women shy away for mathematics and the sciences in general. Following analyses of secondary data to probe women's status in scientific education and employment, Glover concludes that *quantitative* (that is, the number of women studying STEM-related subjects) and *vertical/hierarchical* (that is, the ability of women to rise and pursue STEM-related careers) feminization are different and only weakly related.

According to Glover (2002), the idea of more women studying mathematics is not necessarily tantamount to the number of female who specialist in it. Her study found only a weak correlation between the number of women taking STEM subjects and the number of female specialists in STEM fields. Studies have also shown that male and female students have little or no difference in mathematics performance. The gender gap has been narrowed in many societies and a recent study by Guiso *et al.* (2008) found that the mathematics gender gap disappears in more gender-equal cultures. In the United States, Valla and Ceci (2011) found that in 1970, fewer than 5% of scientific and medical doctorates were awarded to women, but by 2006, the percentages of female doctorates in these fields exceeded 45%.

Some of these stereotypical beliefs have been shown to affect female students' performance in difficult mathematics tests. As early as second grade, Cvencek, Meltzoff, and Greenwald (2011) found male students to identify themselves more strongly than girls in mathematics, and these children believed that mathematics is for boys. These stereotypical beliefs create unnecessary fear in many women towards mathematics, resulting in them boycotting the subject or performing poorly (Hill, Corbett & St Rose, 2010). Women boycotting mathematics has led to scanty numbers of women in the subject compared to men, particularly at higher levels of education. The scanty number of women in mathematics does not seem to owe its explanation to the fact that women have low mental faculties and are unfit for mathematics as Pythagoras and other early mathematicians supposed. Contrarily, some studies have found girls to perform equally to boys in mathematics tests and even better in some cases.

Frenzel and Pekrun (2007) carried out a study on 1,036 male and 1,017 female fifth graders from 42 different schools in the state of Bavaria, Germany and found that these children performed relatively equally in mathematics (assessed in terms of their grades on a scale of 1 for "very good" to 6 for "insufficient"), but the girls reported largely less enjoyment and pride in the subject of mathematics (Mean of girls = 3.23 and Mean of boys = 3.42) but more anxiety, shame and hopelessness than the boys even though their scores

where roughly the same. Although these successes have been recorded and the notion that the female anatomy inhibits mathematic ability is wrong, many girls seem to still possess the mentality that they are not good enough for mathematics and related fields. A more recent study by Matteucci and Mignani (2011) carried out on 1,548 lower secondary school Italian students (49.6% female and 50.4% male) found boys to perform better than girls in mathematics and related subjects.

In order to affect a change in the views of women towards mathematics and related subjects, some authors suggest the development of techniques that affect women's emotions, considering that emotions play a significant role in learning. For example, a study conducted by Ainley, Corrigan and Richardson (2005) on 181 adolescent students concluded that both the substance of students' affective responses to text content and the intensity of their reactions influenced their further participation in a subject area. These authors argued that if students do not engage with the text content from the beginning, the likelihood of them learning is severely restricted. The extent to which students would engage a given subject is dictated by their interest level in it. Furthermore, Ashby, Isen and Turken (1999) argued that inducing and sustaining student interest and raising dopamine levels in the brain (and thus enhancing long-term memory) influence these students' performance levels in many cognitive tasks. This study revealed the necessity for educating women, especially on their capability in mathematics and other sciences; that is, the need to find new ways of motivating women and helping them eliminate the detrimental ideas that they are weak and unable to face "hard" subjects such as mathematics. It seems plausible that if women are motivated, the subject that seemed "hard" before would become "easy."

In a study by McIntyre *et al.* (2003), women who were motivated before taking a difficult mathematics test by being told stories of women role models who had great achievements in mathematics and related fields outperformed women who took the test without having had such motivation. This interesting discovery supports the view that women's poor performance in mathematics and the sciences is closely connected with their thought patterns. These patterns define the self-efficacy beliefs of the individuals and, hence, determine their future career choices. Zeldin *et al*. (2008) found that the sources of inspiration or motivation for men choosing mathematics and related fields differed from those for women. Based on interviews with men and women in such fields, the study showed that whereas men highlighted their mastery experiences as pivotal to their self-efficacy development and, hence, career choices. Women related their self-efficacy development more to vicarious experiences, verbal and social persuasions. This finding implied that the men in mathematics-related vocations believed in their ability before choosing such fields whereas the women were inspired by observing others who served as role models and verbal persuasions from mentors. This buttresses the fact that women are less likely to believe in their ability to excel in mathematics and related fields than men.

Whereas many researchers, such as Halpem *et al.* (2007) in their book *Gender Differences in Mathematics* contend that the low percentage of women in mathematics and related fields owes its explanation to female prejudices, some researchers stand opposed to this assertion. Recently, Ceci *et al.* (2010) argued that discrimination against women is no longer a valid cause for the underrepresentation of women in mathematics but that significant current causes of such low percentages are due more to factors connected with family formation, childbearing, lifestyle choices or career preferences. They contended that girls tend to prefer other fields such as psychology and law in spite of high scores in mathematics and the sciences throughout schooling. Based on a study carried out in Osun state, Southwest Nigeria, Ogunjuyigbe *et al.* (2006) argued that societal norms are the reason for low involvement of women in mathematics; for example, the belief that women are likely to get pregnant and have their studies interrupted.

This problem of underrepresentation of female students in mathematics and related fields which corroborates with the number of women in mathematics-related jobs is known to have its unpleasant effect not just on women but on the larger society. Milgram (2011) contends that the absence of most women from STEM fields and careers affects not only the women themselves but is a missed opportunity for those fields since women often bring in a different perspective that positively shapes and influences STEM disciplines. To Milgram, having more women in these areas will not only benefit the women themselves, but the larger society will gain from their expertise.

The causes of female underrepresentation in mathematics and their performance levels compared to their male counterparts are quite debatable. On the performance level, while some research endeavors find men to outperform women in mathematics and related subjects, others report the reverse. According to Ellison and Swanson (2010) in a study done on students from a number of U.S. high schools, more boys took mathematics courses than girls at the high school level, and large gender gaps existed among high mathematics achievers with boys outperforming girls. These authors also found that whereas the high-achieving boys in the American Mathematics Competitions (AMC) test came from diverse backgrounds, top-scoring girls only came from a limited set of super-elite schools. Masanja (2010) noted that females in Sub-Saharan African schools lag behind males, particularly in mathematics, and stereotypes in education remain clear in such societies with more women tending to study so-called "women related fields," such as nursing and social work, whereas programs in the so-called "hard sciences" are dominated by males.

In sum, female students have stereotypical beliefs towards mathematics, and these attitudes are probably a consequence of weaknesses in cultures around the world that disfavor the girl-child regarding mathematics and related fields. The influence of some of these cultures is quite strong; even where girls perform excellently in mathematics at lower levels, they still do not continue with the subject in higher levels of education. In general, the mathematics gender gap has significantly narrowed, particularly at lower levels of education, in many places around the world. However, girls appear to still retain negative perceptions and, hence, do not continue with mathematics at higher levels.

The issue of female participation in mathematics has attracted much attention both in academia and other social institutions. A portfolio of publications exists in the literature on the underrepresentation of women in mathematics and the STEM fields in general. The majority of published articles focus on the number of females compared with males studying mathematics and the performance levels of both sexes. Studies have been done to determine the reasons why women shy away from mathematics and stereotypical beliefs have been reported as some of the leading causes. However, not many studies have sought to understand when stereotypes emerge in the way female students feel towards mathematics. The purpose of this study was to investigate when stereotypes develop in girls towards mathematics. Knowing when negative attitudes develop in girls towards mathematics and other sciences is valuable because it will enable educators to focus efforts at such grade level.

Method

Participants

Participants were students from fourth through seventh grade in a Midwestern elementary and middle school. A total of 129 (67 female and 62 male) students responded to the survey questions, and all the responses were usable. The average age of the students ranged from 8 to 13 with a standard deviation (SD) of 1.23. The total number of respondents from elementary school was 70, 38 from fourth and 32 from fifth grade. The remaining 59 respondents consisted of 32 sixth graders and 27 seventh graders in middle school.

Procedure

The Assistant Superintendent of Teaching and Learning in the district where the schools in this study are located was contacted at the beginning of the academic year, and he gave his approval for the study. The principals of these schools likewise gave their consent while the Institutional Review Board (IRB) of the sponsoring university also gave their approval. The treatment of the participants was in accordance with the ethical standards of the American Psychological Association.

Approximately two months into the academic year, students completed hard copies of the questionnaire in their classrooms during their various mathematics periods. The class teachers distributed a cross-sectional survey to the students, which simultaneously measured students at different levels. Each student confirmed their willingness to participate by signing a consent form. Students were informed that the purpose of the survey was to investigate their attitudes, beliefs, confidence, and performance level in the learning of mathematics and that the results would help ensure that they have better instruction in the subject. All responses were anonymous, and students were told to feel free to respond as honestly as possible. However, they were also told that they were under no obligation to answer any questions they did

not feel comfortable answering. The responses obtained indicated that all respondents answered all questions in the survey. Students were also informed that the questionnaire would not be seen by their teachers or other school personnel, that the questionnaire asked them for their personal opinions and judgments, and that there were no "right" or "wrong" answers to the questions in the survey. Administration time for the entire survey was an average of 25 minutes from the time the questionnaire was shared until it was collected.

Instrument

In order to assess the effects of students' ages, gender, attitudes, beliefs, confidence, and performance levels in mathematics, questions were designed in these areas. Based on the aforementioned themes, three factors affecting students' mathematics performance were designed using 29 items assessed on a 5-point Likert scale (1 = *Strongly disagree* to 5 = *Strongly agree*). For each item, participants were asked to respond based on how they felt about each statement.

To check the quality of the scales, an exploratory factor analysis was first conducted that included all 29 items and used a varimax rotation to determine if the scales portrayed distinct constructs. Results from the analysis indicated that some items be removed due to negative, weak, or cross loadings on other factors. A subsequent factor analysis indicated four distinct factors with strong item loadings (.60 to .85) that aligned with the hypothesized scales. Internal reliability was found to be sufficient for all of the scales, (α = .79-.86), and the scale distributions all approached normality (that is, skewness and kurtosis less than or equal to +1.00). The scale items were then summed into their respective factor variables. The dependent variable in this study was about student success in mathematics and the following question was asked, "How successful do you feel you are in mathematics?" Students were to respond on a 5-point Likert scale from 1 *"very unsuccessful"* to 5 *"very successful."* The descriptive statistics on this scale were as follows: M 3.74, SD 1.02, skewness 0.22. This scale distribution also approached normality.

Results

Seventy three (73) of the students reported mathematics as one of their best subjects while fifty-six (56) participants said it was not among their best subjects. Of those who reported mathematics as one of their best subject, forty-five (45) were males whereas only twenty-eight (28) were females. At the time this survey was conducted, sixty-four (64) of the students reported an overall "A" grade in mathematics, fifty-three (53) had a "B" grade, while twelve (12) had a "C" grade. Students reported overall grades from their class test and homework.

Correlation

A Pearson correlation coefficient was calculated on the relationship between students' ages, gender, effort, beliefs, levels of confidence and their grades, which represented their performance levels in mathematics. A moderately negative correlation was found between students' effort level and their corresponding grades ($r(127)=-424$, $p<.001$), indicating a significant linear relationship between the two variables. This correlation implied that those students who had lower grades tended to put in more effort in the study of mathematics, whereas those students who had higher grades seemed to put in less effort in the study of the subject. Male students had lower grades, but they tended to study mathematics harder than female students who had better grades in the subject. Most of the factors investigated in this study had a moderate significant positive correlation with success. A moderate positive correlation was found between the confidence students had in mathematics and success ($r(127) = .369$, $p < .001$), indicating that the more confidence students had in mathematics, the more successful they tended to be in the subject. Confidence and effort also had a strong positive correlation, ($r(127) = .847$, $P < .001$), revealing that both of them are high determinants of student success in mathematics. Male students who reported mathematics as one of their best subjects felt more successful than female students who did not consider mathematics as one of their best subjects.

A Pearson correlation was calculated to determine the relationship between the students' grades and the encouragement they received from others. A weak positive insignificant correlation was found (r(127) = .291, P > .05). This result implies that the motivation instilled in the students did not relate strongly to their grades. Most of the other factors, however, correlated strongly with each other, indicating that the factors are all essential parameters in the determination of student success (see Table 1).

Table 1. Correlation among studied variables

	1	2	3	4	5	6	7
Grade	-						
Effort	-.424**	-					
Confidence	-.424**	.847**	-				
Belief	-.397**	.594**	.761**	-			
Encouragement	-.291**	.299**	.225**	.201**	-		
Success	-.160**	.388**	.369**	.238**	.160*	-	
Best Subject	-.397**	.514**	.581**	.540**	.154	.450	-

Note *p<.05, **p<.001

Difference in Students Perception

In order to find out whether there was a significant difference in the way male and female students viewed mathematics, an independent-sample *t test* was conducted, which compared the mean scores of students of both sexes with regards to how successful they felt in mathematics and whether or not they considered the subject to be one of their best. A significant difference was found between how successful female students felt they were in mathematics compared with their male counterparts ($t(127) = 4.13$, $p < .001$). The mean of female students was significantly lower (M = 3.36, SD = .97) than the mean of male students (M = 4.15, SD = .92). This result indicates that more male students felt successful compared to female students. Looking at whether mathematics was one of their best subjects or not, a significant difference was also found ($t(127) = 1.20$, $P < .001$) between the sexes. The mean of female students (M = 1.42, SD = .50) was lower than that of male students (M = 1.73, SD = .45), indicating that female students did not consider mathematics to be among their best subjects, whereas most of their male peers believed the contrary. The analysis on the differences in perception indicates that more female than male students think mathematics is not among their best subjects. Consequently, such female students tend to feel unsuccessful although the results showed that many of these female students performed well in mathematics.

Performance Level Differences

In order to assess whether or not there is a significant difference in the performance level on mathematics between male and female students, an independent-sample *t test* comparing the mean scores of both sexes regarding the grades they had in the subject was performed. No significant difference was found ($t(127)=.27$ $p > .05$). The mean of female students (M=1.61, SD = .70) was slightly higher but not significantly different from that of male students (M =1.58, SD = .62). These means indicate that there are no significant differences in the performance level of male and female students in mathematics. From the above analysis, the result showed no major difference in the performance level of male and female students.

Comparing Elementary and Middle School Female Students Attitudes and Performance

A 2 (Elementary/Middle) *gender between-subject factorial ANOVA was calculated, comparing the grades of elementary and middle school female students. A non-significant main effect for gender was found ($F(1,125) = .12$, $p > .05$), indicating that there were no differences in the performance levels of elementary compared to middle school students. The mean differences between elementary and middle school students was insignificant for both sexes ($F(1,125) = .01$, $p > .05$). Female students in middle school performed almost equally with female students in elementary school. This result means that the performance level of female

students did not depend on whether they were in elementary or middle school. Finally, the interaction between gender and whether students were in elementary or middle school was also not significant ($F(1,125) = .87$, $p > .05$). Thus, it appears that neither the interaction nor whether or not the female students were in elementary or middle school had no significant effect on their grades.

A 2 (Elementary/Middle) *gender between-subjects factorial ANOVA was calculated, comparing whether or not mathematics was one of their best subjects of elementary and middle school female students. A significant main effect for gender was found ($F(1,125)=16.34$, $p<.001$). The mean of female students (M=1.42, SD = .49) was significantly lower than the mean of male students (M =1.73, SD = .45). This result indicates that many female students believed mathematics was not among their best subjects whereas most male students believed that mathematics is one of their best subjects. The main effect whether or not the female students were in elementary or middle school was not significant ($F(1,125)=1.63$, $p>.05$). This finding means that whether students were in elementary or middle school did not make them feel that mathematics was one of their best subjects or not. Finally, the interaction was significant ($F(1,125)=7.98$, $p<.005$). A 2 (Elementary/Middle) *gender between-subject factorial ANOVA was calculated, comparing how successful elementary and middle school female students felt. A significant main effect for gender was found ($F(1,125)=31.9$, $p<.001$), meaning that there is a difference in the way male and female students felt about their success in mathematics. Male students tend to feel more successful (M=4.15, SD=.92) than female students (M=3.26, SD=.97). The main effect whether or not the female students were in elementary or middle school was also significant ($F(1,125)=10.88$, $p<.001$). Elementary school female students felt more successful in mathematics (M=3.89, SD =.14) than middle school female students (M=2.70, SD =.15), indicating that stereotypes start manifesting somewhere between elementary and middle school. Finally, the interaction was also significant ($F(1,125)=.10.88$, $p<.001$). This result means that female students in elementary school feel more successful in mathematics compared to female students in middle school.

In the above analyses, it was found that the mean difference in the performance level of female students between elementary and middle school was not significant. The mean difference in the way they felt about mathematics was significant. This result shows that stereotypes develop between elementary and middle school in female students.

Surfacing of Stereotypes among Elementary and Middle School Students

A 4 (class) *gender between-subject factorial ANOVA was calculated, comparing how successful male and female students felt according to their classes. A significant main effect for class was found (3,121)=12.22, p<.001). Tukey's HSD was used to determine the nature of the differences between the classes relating to gender. This analysis reveals that female and male students in fourth grade did not differ significantly in the way they felt concerning how successful they were about their performance in mathematics. The results for female students in fourth grade were (M=4.33, SD=.73) and male students were (M=4.65, SD=.61). In fifth grade, the analysis reveals a significant main effect in the way male and female students felt concerning how successful they were in their performance in mathematics. Female students had a lower mean (M=3.31, SD=.60) compared to male students (M=3.81, SD=1.05). The significant result in fifth grade means that male students felt more successful in mathematics compared to female students. However, the significant difference was very small. In sixth grade, the analysis showed that there was a significant main effect. Female students had a lower mean (M=2.50, SD=.52) compared to male students (M=4.07, SD=.96). Here, there was a larger difference between male and female students with male students feeling more successful in the subject. In seventh grade, the analysis reveals a significant main effect. Female students felt less successful (M=2.50, SD=.52) compared to their male peers (M=4.07, SD=.96). The effect of students' grade levels influenced the way they felt about how successful they were in mathematics. The significant level increased continually from fifth through seventh grade, meaning that stereotypes started to show in fifth grade and continued as students advanced through seventh grade. In summary, male and female students performed almost equally in mathematics, but male students felt more successful in the subject compared to their female peers.

Discussion

This study was meant to assess if any gender differences exist in the performance levels of male and female students in mathematics at the elementary and middle school levels. A comparison between elementary and middle school students was intended to provide information on the grade level during which stereotypes towards mathematics begin to manifest among female students. Results indicated that the factors, which were used in investigating female stereotype such as effort, beliefs and confidence level, could not individually predict students' performance in mathematics. However, combined effects of these factors were highly predictive of student performance. In general, male students felt more successful and viewed mathematics as one of their best subjects compared to their female colleagues.

Insignificant differences were found in the performance levels of elementary and middle school students in mathematics when comparing all the elementary school students and all middle school students considered in this study. However, the views of these two classes of students towards the subject of mathematics were different, with elementary school students reporting higher levels of confidence and positive beliefs about thriving in mathematics compared to middle school students. Worthy of note in the present study is the fact that stereotypic attitudes in female students were found to manifest from fifth grade and grew stronger up to the seventh grade. According to Muzzatti and Agnoli (2007), stereotypes towards mathematics ability appear in children around ages eight to nine years. The fifth graders involved in this present work were on average between nine and ten years old.

Correlation analyses were performed to check the relationship that the factors involved in this study had with each other. A moderately negative correlation was found between the effort students put in studying mathematics and the grades they earned in the subject. This correlation implied that those students who had lower grades tended to put in more effort in the study of mathematics, whereas students who had higher grades seemed to put in less effort. Results from a study using a 12-quarter panel of course evaluations, from the University of California, San Diego found the link between students' grades and level of effort, concluded that the average study time would be about 50% lower in a class in which the average expected grade was an "A" than in a course taught by the same teacher in which students expected a "C" (Babcock, 2010). However, other studies have found factors such as student effort, parent-child discussions, and associations with positive peers to be strong predictors of students' achievement (Stewart et al. 2008). Students generally spend more time studying what they consider challenging among their subjects and less time on subjects deemed relatively easy, although spending less time studying a given subject like mathematics may also indicate that a student considers the subject to be boring or uninteresting.

Other factors investigated in this study had a moderate significant positive correlation with how successful students felt they were in mathematics. For example, the effort, beliefs and level of confidence students had in mathematics all tended to be positively correlated with their feeling of success, which is judged by the intrinsic motivation borne by students. Middleton and Spanias (1999) refer to this in the following words "intrinsic motivation is related to students' perceptions of their competence in mathematics, to whether they are motivated by curiosity or by grades, and to whether their orientation toward academic achievement can be characterized as mastery orientation" (Bong, 2004, p. 288), which implies to students who are seeking to acquire new information or to improve competence. Broussard and Garrison (2004) in a study involving 122 first-graders and 129 third-graders in Louisiana (43% male and 57% female students) found mastery motivation to be related to higher grades. Mastery motivation entails acquiring competence and influencing one's environment (Eccles, Wigfield, & Schiefele, 1998). A feeling of success results from some inner motivation and the effect of such motivation is generally strong performance in the subject in question. Although effort did not correlate positively with students' grades, it did have a positive correlation with how successful students felt they were in mathematics. Male students who had lower grades tended to put in more effort in studying mathematics, and in the final analysis they felt more successful in the subject compared to their female peers who felt less successful even though they had slightly better grades. The insignificance of the differences in grades between male and female students in this study is in support of an analysis conducted by Hyde et al. (2008) that concluded that the gender gap in mathematics performance no longer exists in the United States of America. This analysis underscores the fact that stereotypic beliefs that women lack mathematical ability is unfounded and so should not exist among women. Based on this present study, one will expect female students with the same performance as males to feel successful in the subject,

but it was not the case. This was quite fascinating because it indicated that female students indeed have a potential for excellence in mathematics but hold stereotypes about the subject.

In this study, it was observed that stereotypes did not exist among fourth grade students but began to surface among fifth grade female students and persisted among sixth and seventh grade female students. Some of the statements used to determine these stereotypes included, *how successful students thought they were in mathematics, whether students considered mathematics as one of their best subjects* and *whether they would like to do mathematics in the future*. Muzzatti and Agnoli (2007) noted that stereotypes towards mathematic ability appear in students around ages eight to nine. However, Fredricks and Eccles (2002) and Jacobs et al. (2002) report that female first grade students approximately six years old, reported more self-perception in arts and languages and lower self-perception of ability in mathematics compared with their male counterparts. In this present study, it was found that stereotypes among female students began to show up at the age ten. It was reported in the National Assessment of Education Progress (NAEP) in 2011 that after sifting through mountains of data, including SAT results and mathematics scores from seven million students who were tested in accordance with the No Child Left Behind Act, a team of scientists said that there is no difference in the performance of male and female students. Whether they looked at average performance, the scores of the most gifted children or students' ability to solve complex mathematics problems, girls measured up to boys. If the performance levels of male and female students are almost the same, the problem then lies in the way they view mathematics. Nosek, Banaji, and Greenwald, (2002) found out that college female students in the United States demonstrated negativity toward mathematics while male students showed positive attitudes toward the subject. Similar results were obtained by Frenzel et al (2007), they found in a study on 1036 male and 1017 female fifth graders in Germany that the performance of both sexes was virtually the same but males reported more confidence, pride, and enjoyment while females reported more anxiety, less enjoyment and less pride in mathematics.

Implication for Practice and Future Research

These findings demonstrate that stereotypes about mathematics performance exist among female students, and that a stereotype among female students begins to show up in fifth grade and increase continually to seventh grade. A key point to note, however, is that although female students have low self-efficacy for mathematics, their performance is not inferior to that of males. This implies that, female students have the potential for mathematics, and that the ideologies of Pythagoras, the President of Harvard and others on female incapability with regards to these fields are unfitting. To help female students gain their self-esteem in mathematics, parents, teachers, educational planners, and even the government should continually remind female students about their good performance in mathematics especially when they get to fourth grade. Talking to them about their good performances will give then the assurance of their ability in mathematics, which will eliminate stereotypes, and hence, motivate them for excellence.

Conclusion

To conclude, the present work illustrated that both male and female students have the potential of doing well in mathematics but that female students have low self-efficacy towards the subject. This was exhibited by a lack of enthusiasm and confidence by female students in the subject compared to the male students. The results also indicated that negative views of mathematics begin to show up in female students from fifth grade and intensify up to seventh grade. In sum, educators need to help female students gain their self-esteem in mathematics because the "leadership tomorrow depends on how we educate our students today, especially in math, science, technology, and engineering" (Obama, 2010, para. 6).

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