Comparing Sixth-Grade Students

From a Small Elementary School

In the Northwest Corner of Connecticut

With Regard to Gender

On the Math Portion of the

2006 Fourth Generation Connecticut Mastery Test

EDM 554 Summer Term 2007, Dr. Richard Fritz

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July 2, 2007
Introduction

Do boys perform better in math than girls? In my six years as an instructional tutor in a small elementary school in northwest Connecticut it seemed to me that girls and boys did equally well in math classes and that girls had loads of confidence about math. I doubted that boys did in fact outperform girls in math at the elementary school level. My perception was that, in general, elementary school boys in grades 3 through 6 simply did not take school as seriously as the girls. In my daughters’ high school, too, judging from the group of AP students which are mostly girls I have come to know, girls seemed to outshine boys in many ways academically. As a result, it seemed that girls were always outperforming boys in all area of academics.

Sixth grade math scores on the CMT during the years 2000 to 2005 showed girls’ and boys’ similarities rather than many differences. In 2006 and 2007 Connecticut 6th grade females performed marginally better than males on the math portion of the CMT, but males took the lead in the advanced level performance. (See Appendix A.) However, in Connecticut, from the years 2001 to 2006, on the Grade 10 Standard CAPT boys performed better in math. (See Appendix B.)

Are my perceptions correct in thinking females always perform better in math than girls? Than why do boys outperform girls on other measures like the CAPT? And the SAT? (See Table 1, page 2a, attached)

Maybe it’s a result of gender bias thrust upon girls and boys. Two extreme and fairly recent cultural signs of gender bias illustrate that our society views females as having a hard time understanding math. Teen Talk Barbie made by Mattel, Inc., said as one of her 270 digital phrases in 1992 – just 15 years ago- “Math class is tough!” (New York Times). And, in 2005,
(not 1955 or even 1975, but just a few years ago), then Harvard President, Dr. Lawrence Summers speaking at a conference in Cambridge applied crude analysis to the research of others to explain that he figured females simply lack the aptitude to do math up to par with males (Summers).

*Teen Talk Barbie* ended up having a total of 269 phrases soon after she landed on shelves once Mattel, Inc. sheepishly deleted the perky math statement from her chip and Dr. Summers is no longer president, replaced in a smooth move with the first-ever Harvard woman president, Dr. Drew Gilpin Faust.

Maybe it a self-fulfilling prophecy: ‘girls aren’t good at math, I’m a girl, therefore, I won’t be good at math’ or conversely, ‘boys are good at math, I’m a boy, therefore, I will be good at math’.

Maybe it’s parent-instilled attitudes that affect girls’ ability to excel in math-related subjects. “An important finding in the achievement literature is that children's self-evaluations of their academic competencies are more strongly related to their parents' appraisals of their academic abilities than to their actual academic performance. We know, in turn, that parents' ability appraisals are colored by their stereotypes about boys' and girls' aptitudes in particular academic domains” (Bhanot).

Maybe it’s just a confidence issue in relation to all of the above. “The traditional approach of focusing on good math grades appears to be effective in encouraging boys to take optional higher level math. For girls, however, the present results suggest that the more important factor is competence beliefs because these beliefs not only have a direct relation to enrollment intentions but also mediate the relation of prior grades to intentions” (Crombie).
The consequences for females not being in the top percentage for math performance are many. A profile of women in engineering shows these two attributes at the top of the list (Vogt): One, they are at the top of the mathematics test score range and two, they are as likely as males to have taken the appropriate prerequisite mathematics, science, and physics courses in high school.

For another thing, there are more males than females in math-related (and high earning) fields. Consider this from Vogt: “Annually, women have earned approximately 25% of the degrees in computer science and less than 20% of the degrees awarded in physics. Moreover, in engineering, the percentage of women graduating from either undergraduate or master's programs is approximately 19% annually. After several decades trying to increase women’s presence in doctoral engineering programs, women only receive slightly less than 20% of the engineering doctorate degrees.” In addition Vogt states, once females opt into engineering, for example, they opt out at a higher rate than males.

Problem

If girls want to have a full roster of career choices in math-related fields available to them, achieving top grades in math is important along with a strong feeling of competence in themselves in relation to math aptitude. “Researchers have described mathematics as a critical filter for future academic and occupational options” (Crombie).

In my six years in a small elementary school in northwest Connecticut it seemed to me that girls and boys did equally well in math classes and that girls had loads of confidence about math. I doubted that boys did in fact outperform girls in math at the elementary school level. This paper will focus on whether or not there exists a significant difference in elementary math achievement for girls vs. boys in a small northwestern Connecticut elementary school in 2006.
Method

Subjects

The data used herein was acquired *ex post facto*. The subjects and their school are described herein:

The rural-suburban school district is located in the northwest portion of Connecticut. The school serves approximately 630 students in grades Pre-K through six in three facilities. In 2006, the 93 sixth grades students whose CMT test results are analyzed in this paper were comprised of 52 females and 41 males. They come from a predominately white population where the per capita income is $30,429.00. The five-year enrollment change in only about 5%, and a little over 94% of the students had preschool experience. Slightly above 80% of the sixth grade students met state goal in math compared to 58.6% statewide. (State of Connecticut, Department of Education – See Appendix C)

Instruments

The data came from the Fourth Generation Connecticut Mastery Test administered in 2005-2006 school year. The principal and curriculum specialist approved my use of this data (see Appendix D) and e-mailed the score roster to me in June, 2007.

Analysis was performed by SPSS 15.0 for Windows Student Version and Microsoft Excel 2003. Also, analysis was retrieved from Connecticut CMT and CAPT Online Reports at http://www.ctreports.com/.

Experimental Design and Procedure

I used the t-Test to analyze the CMT scores. The t-Test is one of the most widely used techniques for testing a hypothesis on the basis of a difference between sample means (Fritz). So,
the t-Test determines a probability that two populations are the same with respect to the variable tested.

The ‘Student’s t-Statistic’ was derived and published in 1908 by William Sealy Gosset who was a statistician for the Guinness brewery in Dublin, Ireland. His job was to monitor the quality of beer brews. He was hired by Claude Guinness whose policy it was to hire graduates from Oxford and Cambridge to apply biochemistry and statistics to Guinness' industrial processes. "Student" was his pen name since Guinness regarded the fact that they were using statistics as a trade secret (Wikipedia).

In statistical software, one might find that t-tests are called Independent Samples t-Test, Two Sample t-Test, and t-Test for Independent Samples. Types of uncorrelated t-tests are separate or pooled. Degrees of freedom for uncorrelated t-Tests can be figured four separate ways depending on criteria for number and variance of data. The assumptions for the t-Test are that the data come from random samples, have a normal distribution (unimodal), and have a homogeneous variance.

I used the t-test to assess whether the math raw score means from CMT of two groups, 6th grade males and 6th grade females, are statistically different from each other. This analysis is appropriate whenever comparison of the means of two groups is necessary. The number of students in each group is not equal and it is a heterogeneous variance.

Since the data was acquired ex post facto, the procedure for my study is not much more that coming up with the null hypotheses which are stated below:

$H_0$ for testing date for variance - There are no significant differences in the variances of 6th-grade male and 6th-grade female variances on the CMT in 2006.

$H_0$ for testing data for differences in the means - There are no significant differences of the means of 6th-grade male and 6th-grade female CMT raw math scores on the 2006 4th Generation CMT.
Results

Please see Appendix E for SPSS analysis. The test for equality of variance is worked out below.

Following is the output table from SPSS after comparing raw scores of females and males:

<table>
<thead>
<tr>
<th>Scores</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>F: 11.665</td>
<td>t: 3.411, df: 91</td>
<td>Mean Difference: 12.678, Sig: .001</td>
</tr>
<tr>
<td></td>
<td>Sig: .001</td>
<td></td>
<td>Std. Error Difference: 3.4979, df: 71</td>
</tr>
<tr>
<td></td>
<td>Upper: 20.062</td>
<td></td>
<td>Lower: 5.2953</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>F: 3.625</td>
<td>t: 83.693</td>
<td>Mean Difference: 12.678, Sig: .000</td>
</tr>
<tr>
<td></td>
<td>Sig: .000</td>
<td></td>
<td>Std. Error Difference: 3.4979, df: 71</td>
</tr>
<tr>
<td></td>
<td>Upper: 19.635</td>
<td></td>
<td>Lower: 5.7222</td>
</tr>
</tbody>
</table>

**Test for Equality of Variance**

F-test = 11.665
Significance Level = 0.010, two tailed
Critical Value = 2.296
(df = 51,40)

The null hypothesis is rejected since the test statistic (11.665) is greater than or equal to the critical Value (2.296). In other words, there are significant differences in the variances of 6th-grade male and 6th-grade female variances on the CMT in 2006. So, the type of uncorrelated t-Test to use is separate, unequal number and variance. The t-Test is performed below:

**t-Test**

t-test = 3.625
Significance Level = 0.010, two tailed
Critical Value = 2.693
(df = average of CV of 51 / CV of 40) = 2.693  
(2.682+2.704/2 = 2.693)

The result is that the null hypothesis is rejected, since the test statistic is greater than or equal to the critical value. In other words, there are significant differences of the means of 6th-grade male and 6th-grade female CMT raw math scores on the 2006 4th Generation CMT.
So, the boys did out-perform girls! Looking at the Descriptives in Appendix F, and see below, the 6th grade boys had a higher mean, a higher median (mid-point), and a higher mode (the score occurring most often). The males had a higher minimum, by far, but a lower maximum score which is significant only until you see on the frequency table, page 2 of Appendix F. Only one female scored higher (138) than the highest scoring boy (134) and, in fact, only 4 females scored in the 130 range vs. 6 males in the 130 range. And, according to statistical scrutiny, it’s significant.

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>52</td>
<td>41</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Mean</td>
<td>103.7115</td>
<td>116.3902</td>
</tr>
<tr>
<td>Median</td>
<td>106.0000</td>
<td>117.0000</td>
</tr>
<tr>
<td>Mode</td>
<td>116.00</td>
<td>129.00</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>21.21074</td>
<td>12.12204</td>
</tr>
<tr>
<td>Variance</td>
<td>449.896</td>
<td>146.944</td>
</tr>
<tr>
<td>Range</td>
<td>93.00</td>
<td>47.00</td>
</tr>
<tr>
<td>Minimum</td>
<td>45.00</td>
<td>87.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>138.00</td>
<td>134.00</td>
</tr>
</tbody>
</table>

**Discussion and Conclusion**

Although there is a statistically significant difference in raw scores on the math portion of the CMT in 2006 between girls and boys at one school in Connecticut, a closer look at breakdown by level shows that girls were close to or above boys on all levels except the most advanced in math. In addition, the state statistics of 6th grade math performance on the CMT show that females out-performed boys. See table from e-Metrics, below. A close scrutiny shows, however, that more boys scored in the most advance level again.
In addition, going back to Table 1 on page 2a, girls’ total scaled scores are increasing at a slightly higher rate than the boys’ scaled scores. Using Microsoft Excel 2003 to create a line graph shows a slight convergence by year 2006. Year 1972 showed 38 scaled points different, while in 2006, the difference was down to 34.

“In fact, differences in performance between males and females have shrunk to nearly insignificant levels on most standardized tests, said Jo Boaler, an associate professor of
mathematics education at the School of Education. ‘There is a huge belief that boys are better at math which is vastly out of proportion to any data that we have,’ Boaler told the audience of about 100, mostly women. "And yet people believe it. You go into schools and the children will tell you that" (Stanford Report).

In addition, the report, "Women, Minorities, and Persons With Disabilities in Science and Engineering," includes data for 1997 through 2004. It shows a steady upward trend in students enrolling in and graduating from science and engineering programs, regardless of race or gender.

Women especially gained ground in science classrooms. The report shows that women received more than a third of the Ph.D.’s awarded in agriculture and atmospheric science, and more women are joining the ranks of astronomers and chemical engineers.

<table>
<thead>
<tr>
<th>Field</th>
<th>Doctoral Degrees Awarded to women each year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1994</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>40.5%</td>
</tr>
<tr>
<td>Computer Sciences</td>
<td>15.2%</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>22.2%</td>
</tr>
<tr>
<td>Math &amp; Statistics</td>
<td>21.1%</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>20.8%</td>
</tr>
<tr>
<td>Engineering</td>
<td>10.9%</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>37%</td>
</tr>
</tbody>
</table>
Londa Schiebinger, the Barbara D. Finberg Director of the Institute for Research on Women and Gender and professor of the history of science, said the following about problems other than academic proficiency that may deter women from achieving the top level in any field:

For example, 43 percent of married female physicists are married to other physicists, whereas only 6 percent of male physicists have physicist spouses. "Where there are two professionals in a family," she said, "it's hard for each to pursue opportunities for advancement when they come by." (Stanford Report)

Maybe then it’s time to work on workplace and compensation equality!
Bibliography


Fritz, Richard. EDM554 Summer 2007 class lectures.


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