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ABSTRACT

Gender differences of gifted and talented students in mathematics performance were examined using the Louisiana Educational Assessment Program (LEAP) of 1995. The LEAP test is a statewide criterion-referenced test administered to all Louisiana public school children in Grades 3, 5, 7, 10, and 11. In this study, the database was restricted to seventh-grade students identified as gifted and talented. Gender, ethnicity, and socioeconomic status served as independent variables. Dependent variables were the nine subskill areas in the mathematics test which measure different aspects of mathematical ability. These subskill areas are: (1) numeration; (2) whole number operations; (3) fraction operations; (4) decimal numbers and operations; (5) percent, ratio, and proportion; (6) measurement; (7) geometry; (8) graphs, probability, and statistics; and (9) pre-algebra. A slight female superiority was found in two mathematics subskill areas; however, the difference was too small to have a practical meaning. No male superiority was found in the nine different mathematical categories. The patterns of gender differences were consistent across ethnic and socioeconomic background. Because LEAP tests were not designed specifically for gifted and talented students, the test may not be a good measure to discriminate among highly intelligent students. (PVD)

Gender Differences of Gifted and Talented Students on Mathematics Performance

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Introduction

The questions of gender differences have been a consuming interest of psychologists and other social scientists for many years. After Maccoby and Jacklin's report (1974), which showed that males exhibited a slight advantage over females in mathematics, much research has been performed on mathematics ability differences between genders. Although numerous studies have been published, the results have been highly inconsistent. One of the reasons for the variation is that the studies are not consistent based on the sample's age, aspect of the mathematical ability, and mathematical ability level. In fact, a person's quantitative or mathematical ability has a developmental nature, so that there are age trends in mathematical ability. A recent meta analysis based on 100 studies (Hyde, Fennema, & Lamon, 1990) showed that there was a slight female superiority in the elementary and middle-school years, a moderate male superiority in high school, and larger male advantages in college and later adulthood.

Also, mathematical ability consists of not one, but several aspects (Halpern, 1992). According to the report of Stones, Beckmann, and Stephens (1982), no significant overall gender differences were found using multivariate procedure that analyzed 10 different mathematical categories at once. But gender differences were found on the individual subskill categories. Female collegians scored statistically significantly higher than males on the tests of mathematical sentences and mathematical reasoning, while male collegians scored higher than females in geometry, measurement, probability and statistics.

Although recently researchers have found that the gender differences in mathematical ability have virtually disappeared (Hyde, Fennema, & Lamon, 1990; Marsh, 1989; Feingold, 1988), gender differences have been reported among intellectually talented preadolescents (Benbow, 1988; Stanley, 1990). Benbow (1988) reported that there were substantial gender differences in the number of girls and boys identified as "exceptionally talented in mathematics." However, Halpern (1988) argued that the result of the report was based on a biased selection related to "masculine society."

Very often, inconsistent gender differences were found across different ethnic and socioeconomic backgrounds (Backman, 1979; Newcombe, Dubas, & Baenninger, 1989; Park & Norton, 1994). When gender differences were detected, greater magnitudes of differences were found in African-Americans than in Caucasians (Park & Norton, 1994). In addition, Halpern (1992) argued that we should examine whether the effect size or the magnitude of gender difference is large enough to be meaningful. It has been recommended that when the statistical testing is performed, not only statistical significance but also the magnitude or effect size should be reported and interpreted (Thompson, 1996).

Based on the issues discussed above, the following research questions were developed.

Research Question 1. Are there gender differences of gifted and talented students on mathematics performance?

Research Question 2. If there are gender differences, which subskill areas show the differences?

Research Question 3. Is the pattern of gender differences consistent across different ethnic or socioeconomic backgrounds?

Research Question 4. If there are statistically significant gender differences, what is the magnitude of the difference?

Methodology

Sample

This study utilized data from the Louisiana Educational Assessment Program (LEAP) of 1995. The LEAP test is a statewide criterion-referenced test which is administered to all Louisiana public schoolchildren in Grades 3, 5, 7, 10, and 11. For the purpose of the current project, the LEAP database was restricted to seventh grade students identified as "Gifted and Talented." Because they make up over 97% of the public school population, the sample includes only African-American and Caucasian students. For this study, 1091 were identified as females and 1090 were identified as males.

Variables

Three independent variables, gender, ethnicity, and socioeconomic status (SES), were included in this project. The SES is a dichotomous variable which has two categories- "Free/reduced lunch" and "Paid lunch". As the dependent variables, the nine subskill areas in the mathematics test are the measures of students' different aspects of mathematical ability. The nine subskill areas are (1) numeration, (2) whole number operations, (3) fraction operations, (4) decimal numbers and operations, (5) percent, ratio, and proportion, (6) measurement, (7) geometry, (8) graphs, probability, and statistics, and (9) pre-algebra.

Analytic Strategy

Data analysis for the current project is directed at explicating the gender differences of gifted and talented students on mathematics ability. In particular, this project is concerned with three issues: (1) whether there are gender differences of gifted and talented students on mathematics performance, (2) whether the gender differences are consistent across nine subskill areas, (3) whether the gender differences are consistent across different ethnic and socioeconomic backgrounds, and (4) the magnitude of gender differences.

Results

Regarding Research Question 1, the results of the multivariate analysis of variance showed that there is a significant effect of gender, Wilk's Lamda (λ) = .968, F (9, 2165)=7.86, $p<0.0001$; specifically there are statistically significant gender differences of gifted and talented students on mathematics performance. Also, significant main effects of ethnicity and SES were found, Wilk's Lamda (λ) = .964, F (9, 2165)=8.90, $p<0.0001$; Wilk's Lamda (λ) = .964, F (9, 2165)=8.90, $p<0.0001$, respectively. However, it should be noted that the magnitudes of differences were only 3 to 4 percent. It indicates that only 3 to 4 percent of variation of mathematics performance can be explained by gender differences for gifted and talented students.

With regard to Research Question 2, a univariate analysis of variance was done on each subskill area. In order to prevent a high Type I error through total nine separate ANOVAs, the alpha level was divided by the number of ANOVAs (0.05/9). Therefore, an alpha level (α) of 0.005 was used to decide whether the gender difference is statistically significant or not for each skill area. Finally, the gender differences were found only two skill areas: whole number operations and fraction operations. In these two skill areas, females outperformed males. Table 1 and 2 show the results of ANOVA for the two skill areas.

Table 1. ANOVA for Whole Number Operations

Source	SS	*df*	F	p<
Gender	31.8	1	8.29	0.004*
Race	29.71	1	7.75	0.0054
SES	123.8	1	32.28	0.0001**
Gender*Race	4.5	1	1.19	0.27
Race*SES	11.77	1	3.07	0.08
Gender*SES	1.19	1	0.31	0.58
Gender*Race*SES	9.7	1	2.54	0.11
Error	8333.99	2173		
Total	8628.56	2180		

Table 2. ANOVA for Fraction Operations

Source	SS	df	F	p<
Gender	104.6	1	20.60	0.0001**
Race	129.9	1	25.58	0.0001**
SES	147.6	1	29.06	0.0001**
Gender*Race	17.6	1	3.46	0.06
Race*SES	0.04	1	0.01	0.93
Gender*SES	7.82	1	1.54	0.22
Gender*Race*SES	2.31	1	0.45	0.50
Error	11036.21	2173		
Total	11658.22	2180		

Regarding Research Question 3, the results of the multivariate analysis of variance showed that there is no interaction effect of gender by SES, Wilk's Lamda (λ)

= .992, F (9, 2165)=1.86, p>0.01; specifically the pattern of gender differences are consistent across two different SES backgrounds of gifted and talented students. Also, there is no interaction effect of gender by ethnicity, Wilk's Lamda (λ) = .989, F (9, 2165)=2.72, p>0.01; specifically the pattern of gender differences are consistent across two ethnic subgroups of gifted and talented students.

Regarding Research Question 4, the mean differences and eta squared (η^2) are presented in Table 3.

Table 3. Mean, Standard Deviation, and Eta Squared (Effect Size) for Whole Number Operations and Fraction Operations

Skill Area	Gender	Mean	Standard Deviation	Eta Squared
Whole Number Operations	Male	10.13	2.09	0.004
	Female	10.49	1.86	
Fraction Operations	Male	10.27	2.46	0.009
	Female	10.69	2.13	

The mean difference (0.36) of the whole number operations skill area is only one-fifth of its corresponding standard deviation (≒2.00). The eta squared which indicates the predictable variation of Gifted and Talented students' performance for whole number operations by gender difference is only 0.4 percent. Also, the effect size (1-λ) from the MANOVA showed that only 3.2 percent of variations were associated between students mathematical performance and gender differences. Therefore, the result of the examination of the magnitudes of association reveals that the gender differences in mathematical ability seems to have disappeared.

Conclusions

In this project, the gender differences of gifted and talented students on their mathematics performance were examined. Like the result of a recent meta analysis (Hyde, Fennema, & Lamon, 1990), a slight female superiority was found in two mathematics subskill areas. However, the magnitude showed that the difference is too small to have a practical meaning. Unlike the result of Benbow (1988) and Stanley (1990), no male superiority was found in nine different mathematical categories. Also, the pattern of gender differences were consistent across different ethnic and socioeconomic backgrounds. As the results of other recent studies show, the gender differences in mathematical ability seems to have virtually disappeared.

Because of the difficulty level of LEAP tests for gifted and talented students, the test might be not a good measure to discriminate among highly intelligent students. Therefore, it is recommended that a more difficult test might be used to differentiate among gifted and talented students on their mathematical performance.

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