Gender Disparity in Mathematics Achievement among the Rural and Urban High School Students in Pakistan

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Abstract:
The Millennium Development Goals require all the nations to eradicate gender disparity at all levels of education by year 2015. Pakistan is far from attaining the target even at the school level. This study took a step forward and explored the gender disparity in high school mathematics achievement in the rural and urban areas of the Province of Punjab, Pakistan. The sample for the study consists of 22,824 boys and 23,796 girls from rural schools, and 18,805 boys and 21,905 girls from urban schools. In all, there are 957 rural schools and 596 urban schools. The data is analyzed by using correlation analysis, univariate ANOVA and multiple regression analysis techniques. It is revealed that the boys performed, on average, significantly higher than girls on mathematics achievement. It is also evident that students from urban schools significantly outperformed their counterparts. The effect of gender and school location was found to be independent of each other.

Keywords: Gender, MDGs, disparity, locale, mathematics, achievement

I. Introduction
Pakistan is a signatory to the United Nation’s Millennium Development Goals that required eradicating gender disparity at all levels of education by 2015. The dream is yet to be realized even at school level. Sizeable allocation for resources and sustained efforts are required to achieve the gender equity in Pakistan. Contrary to the above the public spending on educating has been persistently decreasing since 2006-07: Pakistan spent 2.50%, 2.47%, 2.10%, and 2.05% of the GDP in the years 2006-07, 2007-08, 2008-09, and 2009-10 respectively (Pakistan Economic Survey 2009-10). There were 100 male students for every 75 female students at secondary level in Pakistan in 2007-08 (Pakistan Economic Survey 2008-09). The gender gap in participation in rural areas is wider than that in urban areas. The lowest gender parity index has been reported at secondary level by Pakistan Economic Survey, 2008-09.

Eliminating gender disparity in participation at secondary level is the first step towards providing equitable opportunities for learning, and subsequent career development. Secondary education is an important point in the academic life of children
all over the world. In Pakistan, a large number of students discontinue their education after secondary school and those who continue not all study mathematics as a subject of their choice. Better mathematical knowledge and skills has been considered vital for higher returns in various occupations and professions. Students’ performance on mathematics does affect their future academic and carriers choices. Disparities in mathematics achievement of secondary students, either from rural or urban areas, may potentially reduce the benefits of gender equity in participation. It is therefore important to study the performance of secondary school students on mathematics and identify disparities, if any, among boys and girls from rural and urban secondary school in the Punjab province of Pakistan.

Research on gaps, by gender and locale, in mathematics achievement has been a focus of many researchers (Leder, 1992; Lubienski, McGraw, & Strutchens, 2004) in the western countries and elsewhere since the pioneer study by Maccoby and Jacklin (1974) that reported gender related achievement gaps among students. In achievement tests girls have been outperforming boys in verbal skills whereas boys in general outperform girls on mathematical achievement. The gaps in favor of boys on mathematics achievement are likely to increase as the student age increases (Lubienski, et al., 2004).

These trends in gaps on mathematics achievement have been reported by the researchers all around the world including Pakistan, though inconsistently. In Belgium, a longitudinal study concluded that boys outperform girls in grade 7, by the end of grade 8 they are at par with each other and gender gap increases in favor of boys again in grade 10 and 12 (Van de gaer, Pustjens, Van Damme & De Munter, 2008). The results from German grade 6 classrooms also provided an evidence of gender gaps favoring males on mathematics achievement (Preckel, Goetz, Pekrun, & Kleine, 2008). The research conducted in USA has also indicated boys performing significantly better than girls in grade 4, 8 and 12 at NAEP assessment (McGraw, Lubienski & Strutchens, 2006). In Pakistan, Saeed, Gondal and Bushra (2005) showed boys performing better than girls at various school levels.

The other side of the pictures is portrayed by the literature from various countries that has reported girls’ superior performance than boys. Twelve years old students from Malaysian classrooms participated in a survey that revealed girls outperforming boys on mathematics achievement (Khalid, 1997). It has been reported in the research that gender achievement gap increases with the increase of age (Lubienski, et al., 2004). The research showed Hawaiian girls performing better than boys in 1990, 1992, and 1994 cohorts of 8th graders on SAT (Kiplinger, 1996). Similar results are also reported by the researchers from Taiwan (Chen, 2006) and Australia (Cox, 2000). Researchers from Pakistan have also shown gender gaps favoring female students at school level Curriculum Research and Development Centre (1999) and Andrabi, Das, Khwaja, Vishwanath and Zajonc (2007).

Tsui (2007) did not find any gender gap on mathematics achievement among grade 8 students from China and USA. Else-Quest and Hyde (2010) found large gender gaps favoring males in Tunisia and Korea, favoring females in Jordan and Bahrain and no or negligible gender gaps in many countries including US and Germany. Warwick and
Reimers (1995) conducted the first nationally representative study in Pakistan and found a small impact of gender on mathematics achievement. Recently, Andrab versus et al., (2007) also came up with a similar conclusion.

So far we have been discussing the gender gap on mathematics achievement. The picture becomes complicated when we study gaps on mathematics achievement in the presence of other factors. Locale of schools may also have an impact on mathematics achievement of boys and girls especially in developing countries where same levels of academic facilities are not provided at both the locations. Warwick and Reimers (1995) found that urban student significantly outperformed rural students in grade 4 and 5 in Pakistan. Ten years later, Saeed, Gondal, and Bushra (2005) discovered that rural students performed significantly better than their urban counterparts on mathematics achievement at both grade 3 and 5 in Punjab. Poorer performance of rural students as compared to urban students has also been confirmed by the Academy of Education Planning and Management, Ministry of Education, Pakistan (1999).

Most of the studies carried out in Pakistan have focused on elementary level. The research shows that gaps in mathematics achievement start increasing at high school and continue widening in later years (Lubienski, et al., 2004) in the countries where they exist.

II. Research Questions

This study is aimed at examining the gaps on mathematics achievement of students from rural and urban secondary schools from six districts of Punjab, Pakistan. Particularly, this research responds to the following questions:

1. How does gender, location of a school and mathematics achievement of secondary school students correlate as measured a BISE, in Punjab?
2. How do boys and girls from rural and urban schools compare on mathematics achievement at 9th and 10th grades as measured a BISE, in Punjab?
3. In the presence of gender, is the location of school a predictor of mathematics achievement at 9th and 10th grades as measured by a BISE, in Punjab?

III. Methodology

The system of education in Pakistan requires all the students to participate in Secondary School Certificate Examination (SSCE) at the end of secondary school that is organized by Boards of Intermediate and Secondary Education (BISEs) in each province. Keeping in view the vital role mathematics plays in the national economic development and individual’s welfare, it has always remained as a compulsory subject up to 10th grade for all students, without any exception. Presently same curriculum is offered to all the students irrespective of their gender, stream, motivation or ability. The mathematics strands, algebra and geometry are examined at 9th grade and geometry, trigonometry, information handling and analytical geometry at 10th grade.

This article employed data from 9th and 10th grade examinations administered in spring 2008 and 2009 respectively by BISE in the Province of Punjab. The data set includes all the regular students that appeared in both the examinations. The data
included 22,824 boys from rural and 18,805 from urban schools, and 23,796 girls from rural and 21,905 from urban schools. The schools at the district and tehsil headquarters were categorized as urban school, while all the remaining schools were categorized as rural schools. There were 957 rural and 596 urban schools in the sample.

There were three variables of interest. The independent variables included student gender and school location. The outcome variable – composite achievement score – was obtained by aggregating the scores received by students on 9th and 10th grade BISE examinations that were held in spring 2008 and spring 2009 respectively. The three questions posed by this article are responded by analyzing data using SPSS 17 for windows. Firstly, descriptive statistics was used to explore the data. Secondly, the coefficients were determined for pairwise correlation between all the variables. The univariate analysis of variance was conducted to answer the second question. The third question was answered by using multiple linear regression analysis. The following hypotheses were tested.

IV. Results

The preliminary analysis showed that the mean composite mathematics score of urban school students (84.64) was significantly higher than the rural school students (75.98). The mean composite mathematics score of male students (81.01) was significantly higher than that of female students (79.11). The gap between the mean score of students from rural and urban was wider than the gap between the mean score of male and female students. This study used correlation analysis and multiple regression analysis in order to respond to the research questions. The significance level α was set at .05.

In order to respond to first question correlation analysis was conducted for the pair-wise correlation between dependent and independent variables. The analysis revealed that there is a negligible (Best & Kahn, 1986) but highly significant pair-wise positive correlation between the outcome variable and the predictors. There is a week but significant negative correlation between school location and student gender. On the basis of above analysis it is conclude that there is a significant pairwise correlation between the mathematics score, school location and student gender.

The answer to second question was explored by employing univariate analysis of variance (ANOVA) technique. The results showed that the interaction effect of school location and student gender is not significant, $F(1, 87326) = .174, p \approx .674$. This indicates that the effect of student gender on mathematics is independent of the effect of school location and vice versa.

In the absence of interaction effect, it is appropriate to explore the main effects of student gender and school location on mathematics achievement. The analysis revealed that there is a significant difference between the mean mathematics score of rural and urban students, $F(1, 87326) = 1538.549, p < .001$. The urban students achieved higher mean mathematics score than rural students (mean difference = 8.66). Similarly it is concluded that there is a significant difference in the mean score of male and female students, $F(1, 87326) = 91.881, p < .001$. The male students scored, on average, higher than female students (mean difference = 1.90).
The last research question required the use of multiple regression analysis. The model comparison approach (Judd, McClelland & Ryan, 2009) was used for regression analysis. The models were:

Model A: \[ Y_i = \beta_0 + \beta_1(gender) + \beta_2(school\ location) + \varepsilon_i \]
Model C: \[ Y_i = \beta_0 + \beta_1(gender) + \varepsilon_i \]

First the student gender was entered and then the school location was added. The summary for model A revealed that .1% variation in mathematics score is explained by the student gender and which is a significant predictor of mathematics achievement, \( F(1, 87328) = 72.554, p < .001 \). The coefficients table showed that male students performed significantly better than female students and they are expected to receive, on average, 1.90 points higher than females, \( \beta = 1.90, F(1, 87328) = 72.554, p < .001 \).

The model C predicted the mathematics score by school location in the presence of student gender. The change statistics indicated that school location explains a significant amount of variation in mathematics score over and above student gender, \( R^2 = .017, F(1, 87327) = 1544.13, p < .001 \). This showed that a significant amount of variation in mathematics score (1.7%) is accounted for by school location over and above student gender. The coefficients table suggests that in the presence of student gender, the urban students are expected to perform significantly better than rural students on mathematics achievement, \( \beta = 8.72, F(1, 87327) = 1544.130, p < .001 \). The above analysis leads to the conclusion that location of a school is a significant predictor of high school mathematics achievement when the effect of student gender on mathematics achievement was kept constant.

V. Discussion and Conclusion

The correlation analysis found that the students in the urban schools are expected to achieve higher than the students in the rural schools. Similarly, Boys were expected to achieve higher than the girls at high school mathematics in the province of Punjab. The univariate ANOVA concluded that the effect of school location and student gender on mathematics achievement is independent of each other. In the absence of significant interaction effect, the main effects student gender and school location on mathematics achievement were explored. It was concluded that students in urban schools performed significantly higher than their counterparts in rural schools. The students in urban schools are expected to achieve, on average, 8.66 points higher than the students in rural schools.

It is also concluded that the boys performed significantly higher than the girls on mathematics achievement. Although the gap between the boys and the girls score was 1.90 points yet it was highly significant. It is important to mention here that gender gap in mathematics achievement was independent of effect of school location. The results of the multiple regression analysis concluded that school location is a significant predictor of mathematics achievement over and above the effect of student gender. It is, therefore, concluded that the location of a school is a significant predictor of high school mathematics achievement when the effect of student gender on mathematics achievement was kept constant. These findings are similar to the findings of majority of the research
both at national and international level (Fennema & Sherman, 1978; Leder, 1992; Lubienski, McGraw, & Strutchens, 2004).

The above findings suggest that, in order to realize the MDGs, additional resources and more efforts may be directed towards rural school in order to eradicate gap between the rural and urban schools. Though gender disparity in mathematics achievement is very low, yet it needs serious attention of the policy makers in order to meet the Millennium Development Goals. Achievement in high school mathematics influences the students’ decisions about their higher education and career paths. The students who perform lower than their counterparts remain at disadvantage in choosing their future roles in the society.

The findings of the study suggest that the effect of student gender is very small, though highly significant on mathematics achievement. Similarly, it was found that 1.70% variance in mathematics achievement was explained by the school location controlling for student gender. A large amount of variance remained unaccounted for after considering school location and student gender. The future research may explore other variables such as students’ SES, academic stream, ownership of school, medium of instruction, educational inputs, etc.
References


