An Analytical Study of Gender Difference in Academic Achievement in Mathematics at Secondary Level

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Authors’ contributions

This work was carried out in collaboration between all authors. Author NU designed the study, wrote the protocol and author MY supervised the work. Authors NU and MY carried out all informative work and performed the statistical analysis. Author NU managed the analyses of the study. Author NU wrote the first draft of the manuscript. Authors NU and KD managed the literature searches and author ABG edited the manuscript and wrote the conclusion part. All authors read and approved the final manuscript.

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ABSTRACT

This paper is based on a study conducted in order to have an analysis of gender difference in academic achievement in mathematics at secondary level in district Muzaffar Garh (Punjab, Pakistan). A self-designed multiple choice items test containing forty items was used to collect data from four hundred respondents. According to the findings, the achievement of the male students...
was better than the female students. In area-wise comparison, urban male students performed better than urban female students. The results of this study showed a significant difference in achievement of the male and the female students.

**Keywords:** Gender difference; mathematics; academic achievement; secondary level; students; teachers.

### 1. INTRODUCTION

Education and learning of human beings start with the arrival in this world. Learning takes place as a result of experience and causes a relatively permanent change in the individuals' knowledge and behavior. Learning can occur in formal, non-formal and informal modes. In a formal education system, learning is based on teaching-learnering process. In many cases, at an institution, the students have a variety of differences such as, social and cultural background, intelligence and gender that affect their learning and achievement. Teaching the students, with so many differences among them, is not an easy job. In almost all societies and nations, there is no restriction on individuals to get the education, according to their choices and capabilities. But there are some fields and subject areas differences in aptitude, interest, and achievement with respect to the gender have been found; these areas include subjects like mathematics, engineering, computer technology, accountancy, mining, and business [1,2]. We can expect, that a difference exists in the ways of learning of boys and girls [3]. Although in general intelligence tests no overall difference between men and women is reported, there are some gender differences in particular tasks. Men perform better at certain spatial visual tasks; women excel verbally.

Mathematics has always maintained a core position in curriculum and education as one of the “3Rs" reading, writing and arithmetic. It is considered as a critical filter in the social, economic, and professional development of individuals. It is viewed as a male domain and there are large gender differences favoring males in mathematics achievement. Males are generally considered to have a more positive attitude than females toward mathematics. Boys and girls are treated differently by parents and teachers at home and school. Some teachers believe that the most important gender difference is concerned with working. Several external and internal factors have been stated in the literature for female's limited interest in mathematics. For example, some parents and teachers believe that mathematics is relatively less important for females. They expect that female performance will be lower in mathematics. This attitude affects female interest while studying mathematics [4]. Males and females differ in their expectations for success and failure in mathematics and other science subjects.

Research studies on gender difference in mathematics education and related factors have been conducted from various viewpoints. The question whether boys perform better in mathematics has been a matter of interest for researchers in mathematics education [3]. The assumption is that there is a biological difference between boys and girls that make boys perform better in mathematics. An analysis done in 2005 of 46 meta-analyses that were conducted during the last two decades of the 20th century underscores that men and women are basically alike in terms of personality, cognitive ability, and leadership [5]. Studies consistently found that male performed better than female on mathematical problem solving [6]. Recent studies with reference to American society, confirm that, the females are as likely to enroll in mathematical courses and have higher GPAs as the males do in Mathematics and Science, but their performance is not better in standardized mathematical assessments, than of the males [7].

International trends reveal an increase in overall math performance, but mixed conclusions with regard to performance by gender on mathematical related assessments among K-12 students [8], with differences in achievement by gender at the K-12 level depending on the subject measured and the assessment tool used [9]. At the undergraduate level, there is a clear pattern of fewer females pursuing undergraduate degrees in STEM fields that require advanced mathematical skills [10]. Yazachew Alemu Tenaw [11], were also studied such type of relative approach in the subject of chemistry in relation to gender.

These differences are significance because they have implication for gender isolation in
occupation and public stereotyping. It is important to note that in a variety of occupations we need mathematical knowledge and skill. So, there is a concern for the low performance of girls in mathematics. There is a view that the reason of this difference exists in its timing and strategies adopted by both genders. Studies have indicated that gender differences exist in the type of strategies that students use to solve mathematics problems [12]. It was also found that boys are likely to retrieve information from memory and use covert cognitive strategies.

In this perspective, there are relatively little research studies on gender differences in general and in the field of mathematics in particular. Recently, this issue is being addressed which depicts a picture of mathematics classrooms [13]. In Pakistani society, there is clarity about gender demarcation. Gender role and gender beliefs are unambiguous. In the formal education system, this gender discrimination plays an important role in making decisions, staffing and allocating resources for institutions. Mathematics curriculum used in Pakistani classrooms shows that these materials also favour males rather than females. For example, in the textbooks, the word “problems” mainly makes use of the context of boys’ participation [14]. Similarly, while developing a curriculum and selecting the teaching methods of Mathematics, usually boys are favoured [15]. This inequity in mathematics classrooms indicates that girls are ignored and have less opportunity to involve in a positive manner with mathematics.

1.1 Statement of the Problem

This study was conducted to observe such differences if any. The present study aimed at the analysis of gender difference in academic achievement in mathematics at the secondary level.

1.2 Objectives of the Study

The objectives of the study were:

- To examine the gender difference in students’ academic achievement.
- To find out the relationship between gender and academic achievement.
- To compare the achievement of males and females in urban areas.
- To compare the achievement of males and females in rural areas.
- To find out the relationship between the achievement of male and female in urban and rural areas.

1.3 Significance of the Study

The present investigation will help in making the any type of educational policy, because such type of efforts to restructure the mathematical science to see the level of gender mind setup in future. The Key thought behind this schoolwork is to develop relevancy and appropriate of the discipline to the existing students approach and the educational policy maker’s. Students have a different competency level to understand the science like mathematics, so from this study scheme to assess the vision and thinking approach of gender in studying the knowledge of mathematical science. Thus now it is the responsibility of those people, who involve in the arranging of curriculum of the relative subjects to make a bridge between the student’s interest, parents thinking and the policy of the matter.

2. PROCEDURE OF THE STUDY

2.1 Population and Sample

The students studying in 9th class in 110 government secondary schools of Muzaffar Garh District were taken as population. The sample was selected by using simple random sampling technique, according to the requirement of the research work. The details of the sample are as under.

Eight (8) boys’ secondary schools out of eighty-two (82) and eight (8) girls’ secondary schools out of twenty-eight (28) were selected from the list issued by District Education Officer, Muzaffar Garh. In view of the availability of the respondents, 200 male (100 urban+100 rural) and 200 female (100 urban+100 rural) students were selected randomly. The total sample comprised of four hundred 400 students.

2.2 Development of Research Tool

The development of an achievement test in the subject of mathematics was an important task to generate the data for the study. Therefore, efforts were made to develop a reliable and valid test in the said subject. The test was developed keeping in view the curriculum at the secondary level and textbook published by Punjab Text-book
Board. Items were included in the test from areas of mathematics like set theory, number system, logarithms, algebra, matrices, descriptive geometry, and practical geometry. A multiple choice items format was used and forty-eight items were developed.

2.3 Validation of Research Tool

This test was got validated by the experts available at Bahauddin Zakariya University Multan and in the field. The test was redesigned and improved in the light of suggestions given by the experts.

2.4 Try Out of Research Tool

To ensure validity and reliability of the tool, it was tried out on 15 male and 15 female students. The items of the test were improved further in view of the results of the pilot study. Total forty items were included in the final form of the test. The internal consistency was tested using Cronbach’s alpha reliability test which confirms that reliability of the data was excellent (Cronbach’s alpha coefficient=0.89)

2.5 Administration of the Test

The test was personally administered by the researcher in the selected schools with the consent of the head teachers and class teachers. However, in some female schools, the help of colleagues was sought. As the number of students in each school was reasonable, there was no problem of discipline. The students were told that performance on this test will not affect their individual standing in class, school or board. It was observed that no student was copying each other or cheating.

2.6 Scoring Procedure

No separate answer sheet was used. The students were asked to encircle the option a, b, c and d given against each item on the original test form. They were also told to encircle only one option and not to use ink remover or overwriting. No negative marking was done. Each correct answer was awarded one mark and a wrong answer was awarded 0. Total correct marks were counted according to the scoring key which was already developed.

2.7 Statistical Treatment of Data

The researcher recorded the results on the master sheet and then tabulated. The data were subjected to various statistical treatments. Means and standard deviations were calculated. The significance of variance was also tested using z-test in Minitab software. The comparison of mean scores of the respondents was made by considering gender and location as variables.

3. FINDINGS AND RESULTS

The following findings and results were drawn from the study. The performance of the students was compared using z-test. For this purpose, calculated values were compared to the table value, which was 1.96.

The Arithmetic Mean (A.M.) of the male and female students was 23.48, 20.95 respectively. The calculated value of z-test was greater than the table value. Statistically, there was a significant difference between the mean achievement scores of the male and female students. Further, the difference of mean shows better performance of male students (Table 1).

The Arithmetic Mean (A.M.) of urban male and female sample students was 24.63, 21.84 respectively. Statistically, there was a significant difference between the achievement of male and female students. The difference of mean shows better performance of urban male students (Table 2).

The Arithmetic Mean (A.M.) of urban male students and rural female students was 24.63, 20.05 respectively. Statistically, there was a significant difference between the achievement of urban male students and rural female students. The difference of mean shows better performance of the urban male students (Table 3).

The Arithmetic Mean (A.M.) of rural female students and rural male students was 20.05, 22.32 respectively. Statistically, there was a significant difference between the achievement of female students of government schools and female students of private schools. The difference of means, however, shows the performance of rural male students (Table 4).

The Arithmetic Mean (A.M.) of urban female students was 21.84 and rural male students 22.32. Statistically, there was an insignificant difference between the achievement of rural male and urban female students. However, the difference of mean shows better performance of rural male students (Table 5).
Table 1. Comparison between achievement of male and female

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Calculated z-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>200</td>
<td>20.95</td>
<td>6.21</td>
<td>4.15</td>
</tr>
<tr>
<td>Male</td>
<td>200</td>
<td>23.48</td>
<td>5.97</td>
<td></td>
</tr>
</tbody>
</table>

T. V. = 1.96  
C. V. = 4.15

Table 2. Comparison between achievement of male and female urban

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Calculated z-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>100</td>
<td>21.84</td>
<td>5.84</td>
<td>3.17</td>
</tr>
<tr>
<td>Male</td>
<td>100</td>
<td>24.63</td>
<td>6.55</td>
<td></td>
</tr>
</tbody>
</table>

T. V. = 1.96  
C. V. = 3.17

Table 3. Comparison between achievements of male urban and female rural

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Calculated z-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>100</td>
<td>20.05</td>
<td>6.46</td>
<td>4.98</td>
</tr>
<tr>
<td>Male</td>
<td>100</td>
<td>24.63</td>
<td>6.55</td>
<td></td>
</tr>
</tbody>
</table>

T. V. = 1.96  
C. V. = 4.98

Table 4. Comparison between achievement of male rural and female rural

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Calculated z-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>100</td>
<td>20.05</td>
<td>6.46</td>
<td>2.76</td>
</tr>
<tr>
<td>Male</td>
<td>100</td>
<td>22.32</td>
<td>5.10</td>
<td></td>
</tr>
</tbody>
</table>

T. V. = 1.96  
C. V. = 2.76

Table 5. Comparison of achievement of male rural and female urban

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Calculated z-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>100</td>
<td>21.84</td>
<td>5.84</td>
<td>0.62</td>
</tr>
<tr>
<td>Male</td>
<td>100</td>
<td>22.32</td>
<td>5.10</td>
<td></td>
</tr>
</tbody>
</table>

T. V. = 1.96  
C. V. = 0.62

4. RMANOVA

A repeated measures analysis of variance (RMANOVA) confirms that the effect of gender (F=34.74, p<.001) but not locality (F=2.43, p>.1) is significant. The interaction between gender and locality is also not significant (F=1.86, p>.1).

5. DISCUSSION

This study was conducted to analyze the performance of male and female students to see the impact of gender difference on academic achievement in mathematics at the secondary level. Gender difference was considered as the factor which affects the achievement of the students. A multiple choice item test was developed and administered at the end of the academic year to the sample of students (200 male and 200 female) to generate data about their achievement in mathematics. As the sample was selected randomly, the results of the comparison of mean scores and critical z-value of the students’ performance on the test were considered as the impact of gender difference on achievement. Statistically significant difference between the performance of males and females, urban males and rural females, rural males and the urban females was observed. A repeated measures analysis of variance (RMANOVA) also confirms that the effect of gender (F=34.74, p<.001) but not locality (F=2.43, p>.1) is significant. The interaction between gender and locality is also not significant (F=1.86, p>.1).
6. CONCLUSIONS

From this study it is concluded that the mathematical approach of urban male students to understand the subjects are better than the urban female and comparatively such type of approach in urban male is better than the rural females. In addition, the performance of rural males is proportionally better than the female of rural areas. But the reflection of results towards the performance of rural males and urban females is not significant. At last it is hypothesized that the overall performance of male students in mathematics and its related sciences is better than the female.

7. CONTRIBUTION FOR FUTURE RESEARCH

1. Parent –teacher meetings should be arranged to enhance awareness of parents about the performance of children. Parents’ involvement is an important factor that affects students’ achievement. These meeting will help the parents to change their attitude toward girls and to provide them equal opportunities.

2. Availability of mathematics teacher should be made ensured particularly in girls schools. For this purpose, pre -service and in -service teachers’ training should be provided to the female teachers to enhance the quality of teachers.

3. To meet unique needs of boys and girls, an innovative classroom arrangement should be considered that customizes teaching and learning.

4. Attention should be given early to late middle schooling years during adolescence because gender differences emerge at early secondary school years.

5. The teachers should keep themselves aware of the latest researches in mathematics so that they should be able to impart fresh knowledge to students.

6. Textbooks development should be made keeping in view the gender differences among students. Use of the language reflecting gender discrimination should be avoided in the textbooks.

7. Students especially females should be encouraged on better performance in mathematics. Management should arrange healthy competitive examination among the boys and girls schools for encouragement.

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COMPETING INTEREST

Authors have declared that no competing interests exist.

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