

## **Analysis of Secondary School Students' Achievements in Geometrical Part of Mathematics**

**Nasreen Akhter\***  
**Ahmad Akhtar Usmani\*\***

### **Abstract**

*This survey study was designed to evaluate students' achievement in Geometry part of Mathematics at the secondary level in Punjab, Pakistan. A sample of the study was 40 schools and 392 students selected by multistage sampling from Punjab including five districts. The tool of the study that was a standardized test of Geometry having 48 multiple choice test items of knowledge, comprehension and application levels according to the levels of cognitive domains from the content of geometrical part of Mathematics for class 9<sup>th</sup> taught in Punjab, Pakistan. Results indicated that students were better in rote memorization related exercises in comparison to performing comprehension and application-based tasks. The students who had achieved more than 80% marks in 9<sup>th</sup> class board examination of Mathematics attained poor marks in the standardized Geometry test. Comparative analysis of students' scores concluded that girls and urban students were best than all. Regarding the teachers' work experience this study found that teachers with experience of above 16 years working in schools could not help learners to attain better scores in the test. This study suggests improving the geometry teaching in schools and promoting use of standardized tests in Board examinations in the Mathematics.*

**Keywords:** Mathematics, achievement, geometry learning, standardized test, secondary education.

### **Introduction**

Mathematics introduces an assurance of knowledge and wisdom to learners. It initiates varying degree of factual and realistic skills which is related to the practical life of human beings. It is learnt specifically because of its' utilization and application in practical life. Past studies about learners' attitude towards mathematics teaching have been reviewing continuously by different researchers in different parts of the world.

---

\* Assistant Professor, Department of Education, The Islamia University of Bahawalpur

\*\*Ph. D scholar, Department of Education, The Islamia University of Bahawalpur

The analysis of quality of its' teaching has importance in the past researches. Therefore, mathematics is taught compulsorily and learnt attentively in different regions of the world (Boyer, 2008).

Akhter and Akhter (2018) while describing the attitude of school level students towards mathematics described that mathematics is a compulsory subject taught up to Matric in Pakistan. At the secondary level, the course of mathematics includes; numbers and operations, measurements and geometry, algebra, information handling and logical thinking and reasoning. Students admit that mathematics is valuable subject.

The course of Mathematics of secondary classes contains different portions by content and Geometry is one of them. All contents taught in mathematics have specific value and significance of Geometry in Mathematics is also not fake. Specifically, Geometry is a branch of mathematics concerned with questions of shape, the size, relative position of figures, and the properties of space. It covers a whole range of concepts which are encountered in the everyday life of human beings and has many practical applications in different fields of life. There are many professions which use geometry experts to perform their jobs (Courant, 2006).

Geometry encompasses a whole range of concepts including triangles and trigonometry, area and perimeters, lines and angles, and all other shape related problems. Studying geometry is important to develop skills such as logic, problem solving and spatial understanding. Geometry problems might also become number problems or algebra problems, so it is important to make sure children are properly prepared by using quality geometry (Wright, 2003).

Geometry is linked to the other areas of Mathematics. Children begin learning about shapes and this knowledge consistently built upon as they progress through their education. When they approach their examinations, they realize there is a lot more to circles than they originally thought about geometry. There is a thought that mathematics learning demands rote memorization. Therefore, demands a lot of practice for perfection. But, Reid (2009) asserts a view that learning activities in this subject demands high conceptual demands. Although, many are not applied in common in routine life but are utilized specifically many times.

Previous studies related to the assessment of students in the subject of mathematics indicates that Geometry teaching is much difficult than that of arithmetical procedures and simple Algebra (Duval, 1998). In spite of the virtual position of mathematics, it is unacceptable to note that the student's attainment in the geometry examinations has remained constantly weak (Salao, 1995; Amazigbo, 2000). The results from the study of Ozerem (2012) revealed that 7th class students have a number of mis apprehensions, poor contextual familiarity, intellectual and basic operation blunders at the topics related to geometry. Lateron, Ali, Bhagawati and Sarmah (2014)

explored that learning in geometry is very poor among most secondary class students. In most of the cases, students face difficulty in geometry part of their mathematics curriculum. Sinclair and Bruce (2015) observed that children enter school with informal conceptions about the geometry. Although, the whole Mathematics is difficult, but in comparison to other sections of mathematics, geometry is the most difficult part for school students.

Several studies have tested numerous methods of teaching geometry and found serious complications in geometry learners. Like as; imperfect understanding of the problematic and mathematical signs, constructing verifications created on direct visual basics, missing tactical information in making proofs in learning geometry etc. The responsible factors for the weak performance of students in geometry as identified by researchers include; poor primary school background in mathematics, lack of rewards for teachers, non-qualified teachers in the organizations, thinking of mathematics is complicated, large classes and emotional horror of the subject (Amazigbo, 2000) weak background of teachers in the mathematics and students' lack of interest and motivation in learning geometry due to its' difficulty, negative self-perception, conception about less relevance of Geometry in students' daily life and lack of literature on geometry teaching (Ali, Bhagawati & Sarmah, 2014).

Chiu and Xihua (2008) found a strong effect of family and positive self-conception of students on learning performance in Mathematics. In his observation, single parent children attain lower marks in the subject. But, high SES, fewer elder siblings, availability of multiple books to the students, interest in learning mathematics help students to perform well in the mathematics. Erdogon, Baloglu and Kesici (2011) state that most studies support gender differences in mathematics learning and favour men for better results in the subject in secondary classes but they found different results. Their study supported that girls were better in learning mathematics and geometry. Therefore, learning in concepts related to geometry, girls are better than boys.

By the quality assessment point of view, the attitude of students towards all components of mathematics has been studying continuously since many decades. Researchers have used a number of testing tools to explore students' strengths, weaknesses, liking and disliking in searching the ways to improve mathematics teaching. A major problem in the assessment of students' achievement is that valid and reliable tests and tools are not available to researchers in Pakistan. Therefore, assessment results are not only being criticized by users but also become useless for educators sometimes because of deficiency by producing invalid and unreliable results. A conception produced by researchers indicates that analysis of students' achievement based on standardized tests can explore weaknesses in the instructional process and assessment of teachers. Use of standardized tests that are valid and reliable to evaluate

students learning can help educators to search out the deficiencies in teaching and learning process of mathematics teaching and awarding valid grades to students.

### *Statement of the Problem*

The present study is an attempt to search out students' learning achievement in geometry using a standardized achievement test. In this study, an achievement test having multiple choice type items was used. On the basis of data of the study, learning achievement of secondary school students from different dimensions was analyzed to conclude weak areas in teaching the geometry component of mathematics course.

### *Objectives of the Study*

Objectives of the study were;

1. Analyze the secondary school students' learning achievement in the course of Geometry using a semi-standardized test.
2. Evaluate students' learning achievement in the geometry comparing their skills related to the learning levels.
3. Search out effect of gender, locality, teachers' experience of teaching and use of type of test by construction procedure on the examination results of students in the course of geometry.

### *Significance of the Study*

The present study is valuable for mathematics teachers to understand deficiencies among secondary class students related to learning the geometry. Teachers can find out areas that need focus of attention while teaching geometry and planning the valid and reliable methods for assessment of students.

### **Research Methodology**

This study was conducted following the procedure of survey method of descriptive research. Keeping in view the available resources, this study was confined to Punjab Province of Pakistan and evaluated English medium science students' achievement in geometry in the 9<sup>th</sup> class only.

### *Population and Sampling*

All students who had completed the course of the 9<sup>th</sup> class were population of study. Data of study was collected during the academic session 2017 to 2018. It was examined that students studying in the 10<sup>th</sup> class had completed the course of 9<sup>th</sup> class. Therefore, students of 10<sup>th</sup> class of different schools in Punjab province were the population of the study. At sampling stage, Multistage sampling including 40 secondary English medium schools and 392 students from five district of Punjab province namely; Lahore, Multan, Rawalpindi, Faisal Abad and Bahawalpur was done.

### *Tool of Research*

The tool of the study was a standardized test of Geometry (that was a part of Mathematics) for the classes 9<sup>th</sup> in the English language that was already prepared by the researchers. The test had 48 multiple choice items related to the first three levels of cognitive domains according to Blooms Taxonomy. Validity of test was determined through expert opinion method. Its' reliability was in good range (0.86) with a low level of standard error of measurement (3.21).

### *Data Collection and Its Analysis*

Data of the study was collected in examination conditions from the students of 10<sup>th</sup> class. At the day of the test, list of all students present in class was taken and ten students from each school were randomly selected. But some students (8 out of 400) denied sitting in examination because it was surprising test. Therefore, they were not pressurized. In this way, 392 students attempted the test. Participants were informed about the test on the day of test. It was ensured that all participants had completed the course of the 9<sup>th</sup> class and had promoted to the 10<sup>th</sup> class getting passing marks in Mathematics according to BISE in respective regions. For data analysis, statistical package for social sciences was used to draw the results of the study applying descriptive and inferential statistics.

### **Results and Interpretation**

Data of this study is based on responses of 392 students. Keeping in view the objectives of the study, key results have been given in the next.

#### *Students' learning achievement in the geometry*

To search out the students' mastery on the geometry, result of students was analyzed concluding the mean, median, mode, maximum and minimum scores of students in the test and comparing scores of high, average and low achievers. Results have given in table 1 and 2.

Table 1

*Summary of the achieved scores of students in the test (n= 392)*

Total scores	Maximum attained score	Minimum attained Score	Range	Mean	Median	Mode
48	41 85%	13 27%	28	28 58%	28 58%	27 56%

Analysis of students' attained scores in test explains that students achieved scores between 13 (27%) to 41 (85%). The average 28 (58%) and median score is 28 (58%) that are below the cut point for B grade/ first division marks according to rules of grading the subject in board examinations in matriculation. The analysis also shows that

most frequent score attained by the students is 27 (56%) in the distribution of scores. This analysis explores that majority of students are not outstanding in performing the geometry problems. They have attained average level scores in the geometry test.

Table 2

*Summary of different level groups' performance in the test*

	N	Range	Minimum	Maximum	Mean	Std. Deviation
High achievers	100	10.00	31.00	41.00	34	2.24
Average group	292	18.00	13.00	31.00	25	3.92
Low achievers	100	11.00	13.00	24.00	21	2.73
	392	28.00	13.00	41.00	28	5.10

Table 2 exhibits data regarding the comparison of achieved scores by high achievers with the average group and low achievers in the test. It exhibits that in relation to the maximum score and mean score, high achievers were always best than average and low achievers. Moreover, low achievers were poor than average and high achievers in attaining maximum and mean score in the test. This indicates that the test used as tool to analyze students' achievement in the subject differentiated between different ability students.

*Students' command in geometry related to learning levels*

The test used in this study had test items related to knowledge, comprehension and application levels according to definition of Blooms' taxonomy of educational domains. To evaluate the teaching and learning standard in geometry, scores of students in knowledge, comprehension and application level test items were compared. Results have given in the table 3 and 4.

Table 3

*Comparison of students' performance in relation to learning levels*

Level of learning	Total	Range	Minimum		Maximum		Mean	
	scores	Scores	Scores	%	Scores	%	Scores	%
Knowledge (17)	17	13	3	18	16	94	10	58
Comprehension (13)	13	11	2	15	13	100	7	54
Application (18)	18	15	2	13	17	94	10	56
Total (48)	48	28	13	27	41	85	28	58

Note= Number in ( ) shows number of items in related group

Table 3 exhibits data about the descriptive statistics regarding students' attained scores. Analysis of average score of the whole group illustrates that students attained the best scores in knowledge level related items (mean= 10/17, 58%). Students showed

command on application related items on middle (mean= 10/18, 56%) and attained lowest mean scores in comprehension level related items (mean = 7/13, 54%). On the whole, it is derived that students have almost nearly equal level command on all learning levels but average students are mostly poor in the comprehension level related components.

Table 4

*Comparison of high, average and low achievers in different learning level items*

		n	Range	Minimum	Maximum	Mean	SD
Knowledge	High achievers	100	7.00	9.00	16.00	11.84	1.71
	Average group	192	11.00	3.00	14.00	8.21	1.99
	Low achievers	100	9.00	3.00	12.00	7.34	1.78
Comprehension	High achievers	100	7.00	6.00	13.00	9.12	1.42
	Average group	192	9.00	2.00	11.00	6.24	1.81
	Low achievers	100	8.00	2.00	10.00	5.52	1.75
Application	High achievers	100	8.00	9.00	17.00	12.79	1.44
	Average group	192	11.00	2.00	13.00	8.91	1.91
	Low achievers	100	10.00	2.00	12.00	8.01	1.79

Table 4 presents a comparison of students' scores in the test in relation to knowledge, comprehension and application related items. Results indicate that high achievers performed better in the test in comparison to the average and below average/ low achiever groups in all levels related portions of the test. Low achievers also performed poor than the average group and high achievers in all portions of the test. This also signifies that test used for the assessment of students learning in the course was suitable in evaluating students learning by discriminating best to average, average to poor and best to poor.

*Effect of gender, locality and teaching experience of the teacher on learning achievement of students in geometry*

Table 5

*Comparison of students' scores in the test on the basis of background demographic variables*

Variable	Groups	n	M	SD
Gender of student	Boys	229	27.48	5.10
	Girls	163	27.53	5.14
Locality of student	Rural	235	27.34	5.13
	Urban	157	27.73	5.09
Teaching experience of the teacher	13 or fewer years	131	27.08	5.17
	14 to 15 years	208	28.02	5.32
	16 and above	53	26.47	3.79

Table 5 exhibits that boys versus girls and rural versus urban are almost the same in geometry. But on the whole girls and urban students are minutely better than boys and rural students. On the whole, teachers with teaching experience of 14 to 15 years seem best to guide students in learning geometry. Students of most experienced teachers perform minutely low than the students of less experienced teachers in the course.

*Impact of type of test by test construction procedure on the learning achievement of students*

A purpose of this study was to evaluate the impact of type of test by construction procedure on the scores of students. Therefore, marks of students in whole mathematics were recorded from the school records because result in geometry separately was not announced separately by the boards of examinations. Then, marks in board examination and marks of students in the test in present study were compared. Results have given in table 6.



Table 6

*Comparison of students' scores in the standardized Geometry test with their marks in mathematics in their previous board examination*

Marks in Mathematics in board examination	n	Average Marks% in the standardized test
More than 80%	66	37%
60% to 79%	105	32%
34% to 59%	172	21%
33%	49	10%
Total	392	100

Table 6 explains a comparison of students' scores in present Geometry test to their marks of mathematics in 9<sup>th</sup> class Mathematics in board examination. It explains that 66 (17%) students who obtained 80% and above marks in their board examinations could attain only 37% marks in the Geometry test conducted in the present study. Unfortunately, remaining group 326 students (83%) could not even pass the geometry test according to the boards' passing criterion. This situation can be because of difference in the difficulty level of tests administered in the board examination and present study. This difference can also be because of the reason that students attempted non-standardized tests in board examination but in the present study, a standardized test was used. A reason behind the situation is possibility of the effect of use of a surprising test strategy too. In examinations, students do extensive practice before examinations to perform well in the examinations. But after passing a short time period, students start losing their command on the skill to solve mathematics items. This analysis explores that surprising tests and standardized tests are difficult for students than planned and teacher-made tests.

### **Discussion and Conclusion**

The present study was conducted with the objective to evaluate students' achievement in geometry from different aspects to find out strong and weaker areas in relation to students, teachers and management of schools. In the light of the results of this study, it has concluded that students in geometry are not so good. Analysis of result of students included in sample concluded that students achieving 80% marks in board examinations could achieve 37% marks in geometry part. This concludes that students are poor in geometry. But, keeping in view the fact of characteristics of standardized and non-standardized tests, one should keep in mind that standardized tests no doubt produce valid, reliable and objective results for evaluators but are difficult for students mostly. Moreover, in examinations students do a lot of practice and focus to memorize contents before examinations. But, after passing a short period of time, they start to lose their memorization about memorized facts. So, the possibility of an effect of the time period and the use of a type of test by construction process is possible in finding poor

attainment of students in this study. Moreover, the fact in light of conclusions of previous studies (Salao, 1995; Amazigo, 2000; Ozerem, 2012; Ali, Bhagawati & Sarmah (2014) about the complexity of geometry in comparison to Arithmetical and simple Algebra concepts should also be kept in mind.

The present study, in relation to students' background characteristics like gender and locality although indicated not a big difference between boys versus girls and rural versus urban students. But a minute observation of average scores of groups in this study explored that girls and urban groups were better than boys and rural students. In relation to the effect of locality on learning achievement of students in Geometry, it is a fact that students in urban areas have better facilities in the sense of school related factors and teachers. Therefore, urban students in whole attained better than rural area students. In past, Chiu and Xihua (2008) have explored the effect of availability of a number of books, number of siblings in the family, and high SES on students' attainment in geometry. Moreover, Erdogon, Baloglu and Kesici (2011) explored that girls are better than boys in learning mathematics and geometry as well. Therefore, having a view about the general understanding regarding culture and available facilities in Pakistan, it is a fact that rural areas have a culture of more siblings but fewer facilities for good learning in schools, availability of multiple books and teachers with a high profile in relation to qualification and training in teaching geometry. Because, as soon as qualified teachers get the opportunity to get a good job in urban areas, teachers prefer to migrate towards cities to avail better facilities and more employment opportunities. So, the result regarding the effect of SES, socio culture and other factors related to socio-culture, result of this study supports the results of Chiu and Xihua (2008).

About the effect of gender, the results of this study resemble the conclusion of Erdogon, Baloglu and Kesici (2011) who found girls better in geometry than the boys. The results regarding effect of teachers' qualification on students' scores in the test indicates a negative effect of teachers' experience on students' scores in the test. This is strange because experience of teachers is considered positively related to the learning performance of teachers. This finding leads a question to search out the reason for this result. Therefore, a further study to verify authenticity of this result is needed. Moreover, if this finds true then reasons for negative effect of teachers experience on learning performance of teachers should be explored by conducting a research on large scale.

## **References**

- Akhter, N. & Akhter, N. (2018). Learning in mathematics: difficulties and perceptions of students. *Journal of Educational Research*, 21(1), 147–163.
- Ali, I. Bhagawati, S. & Sarmah, J. (2014). Performance of geometry among the secondary school students of Bhurbandha CD block of Morigaon District, Assam, India. *International Journal of Innovative research & Development*, 11(3), 73-77. Available on [www.ijird.com](http://www.ijird.com).
- Amazigo, J. (July, 2000). *Mathematics Phobia Diagnosis and Prescription*. Abuja: National Mathematics Centre first annual lecture, Abuja.
- Boyer, C. (2008). *A History of Mathematics*. New York: Wiley.
- Chiu, M. & Xihua, Z. (2008). Family and motivation effects on mathematics achievement: Analyses of students in 41 countries. *Learning and Instruction*, 18 (4) 321-336
- Clements, D.H., & Sarama, J. (2007). Effects of a preschool mathematics curriculum: Summative research on the building blocks project. *Journal for Research in Mathematics Education*, 38, 136-163.
- Courant, R., & Robbins, H. (2006). *What is Mathematics?* New York: Oxford University Press.
- Erdogon, A., Baloglu, M.& Kesici, S. (2011). Gender differences in geometry and mathematics achievement and self efficacy beliefs in geometry. *Egitim Arastrimalari Eurasian Journal of Educational Research*, 43 (spring), 91–106.
- Ozerem, A. (2012). Misconceptions in Geometry and suggested solutions for seventh grade students. *Procedia - Social and Behavioral Sciences*, 55 (2012), 720 – 729 Available online at [www.sciencedirect.com](http://www.sciencedirect.com)
- Reid, N. (2009b). Working memory and science education, *Research in Science and Technological Education*, 27(2), 245-250.
- Salao, M.O. (1995). Analysis of students' enrollment and performance in Mathematics at senior secondary certificate level. *Journal of curriculum studies*, 5 & 6 (1,2), 1-8.
- Sinclair, N. & Bruce C.D. (2015). New opportunities in geometry education at the primary school. *ZDM: The International Journal on Mathematics Education*, 47 (3), p319-329 DOI 10.1007/s11858-015-0693-4
- Wright, R.J. (2003). A mathematics recovery: Program of intervention in early number learning. *Australian Journal of Learning Disabilities*, 8(4), 6-11.