A Study of Secondary School Students' Attitude Towards Mathematics in Tehsil Taxila

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Abstract

Students' progress in mathematics is determined by their attitude towards Mathematics. A positive attitude towards a subject is the prerequisite for success in any subject. This is also true in mathematics, particularly when girls are compared to boys. This research was conducted to investigate secondary school students' attitudes towards Mathematics. The population included 1562 secondary school students of both genders. A cross-sectional survey was conducted and 368 students (male=184 & female= 184) of secondary schools from tehsil Taxila were selected through a simple random sampling technique. A Mathematics Attitude Scale was used to collect the data. The scale consisted of 19 items based on four factors i.e. 1) Enjoyment 2) Fear, Anxiety, and Distress 3) The use of Mathematics in everyday life 4) Perceived Mathematics Achievement. A gender-wise comparative analysis of Mathematics attitude showed that female students have high anxiety and fear level as compared to male students. The findings of the study also indicated that female students at the secondary level have a lower attitude toward mathematics as compared to male students.

Keywords**:** *Mathematics Education, Students Attitude, Mathematics Anxiety*

1. Introduction

Attitudes refer to expressing the evaluation of something or someone (Reid, 2015). Attitudes are built on someone's feelings and knowledge. It deeply influences the future behavior of individuals (Orton, Orton & Frobisher, 2004). Attitudes always change according to the situation. The individual's response to the situation is based on their feelings, values, and beliefs (Deci & Ryan, 2002). Attitude plays a pivotal role in human identity. Every day people engage in certain activities which revolve around different attitudes such as favor, love, oppose, dislike, agree, and disagree. These reflect an evaluative human response to certain objects. So, attitudes may be defined as the summary of the evaluation of human thoughts towards different objects (Bohner & Wänke, 2002).

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Therefore, attitude is a complex phenomenon and has a lasting effect on performance and learning (Pisa, 2003).

Attitude is an important factor in the teaching of mathematics as a subject. Because it affects the scores of students in mathematics. However, students' attitudes towards mathematics are further affected by different factors such as the teaching methodologies of teachers and school structure. But on the other hand, it is also observed that the methodology and teaching style of mathematics teachers were good enough in the classroom, but still, the students found alienated from the subject of mathematics (Barton, 2000; Furinghetti & Pekhonen, 2002). Research has shown that students' attitudes towards mathematics have a significant impact on their academic achievement in the subject. Students with a positive attitude toward mathematics are more likely to have higher levels of achievement (Birenbaum & Nasser, 2017; Han, 2018). On the other hand, students with a negative attitude toward mathematics are more likely to experience difficulties in the subject and may require additional support (McLeod & McLeod, 2003). These matters may lead to the cause that the achievement of students in mathematics became a matter of great concern all over the world in past years (Pisa, 2003).

Mathematics is one of those subjects which are taught both at college and school levels more as compared to other subjects throughout the world (Orton, Orton & Frobisher, 2004). Usually, students talk about mathematics when they inquire about their homework in the subject that, “I did not know how to do it”. “That is why I did not finish it”. “I don’t like Math”. Mathematics is referred to as the queen of all sciences but still, many people do not understand this subject, however, mathematics is an interesting subject for many students as it contains symbols, shapes, and figures (Mata, et.al, 2012).

Mathematical concepts are used in every domain of learning and everyday life. The mathematical expertise of instructors was found to be highly associated with students’ success in math; the research emphasized the importance of having highly qualified instructors with subject-matter expertise so that pupils can excel at math (Hill, Rowan, & Ball, 2005). Making math enjoyable for all students requires an understanding of how their attitudes and performance are impacted by how they perceive what they're learning. The literature has discussed the learner’s positive and negative attitudes towards mathematics in various ways such as Kibrislioglu (2016) said that it is a like or dislike and inclination of students to avoid or engage in mathematical activities. Mahanta (2014) has identified many factors which are responsible for positive or negative attitudes in mathematics i.e., family role, the role of cognitive and affective domains, self-efficacy, beliefs, and perceptions. Finally, the perceived

difficulty of mathematics can also contribute to negative attitudes, as students may view the subject as inaccessible or irrelevant to their lives (Lutovac & Vukovic, 2019).

Generally, in Pakistan, the understanding of mathematics as a subject for the students both in public and private schools is like a nightmare. Hence the role of mathematics in the field of science and technology cannot be ignored. Therefore, keeping the importance of mathematics it is being taught as a compulsory subject all over Pakistan from primary to high school level. But on the other hand, teaching staff the subject of mathematics could not inculcate critical thinking and analytical abilities in students which results that they cannot make any emotional disposition toward mathematics (Government of Pakistan, 2009). However, research showed that a positive belief and attitude of students toward mathematics results in better academic achievement in the subject (Ashcraft & Kirk, 2001;Schenkel, 2009). Therefore, mathematics curriculum and teaching need to provide knowledge and skills to students which are essential in changing technological work (Ngussa & Mbuti, 2017).

1.1 Objectives of Study

Objectives of this study included to:

1. determine the level of secondary students' attitude towards mathematics.
2. compare the attitude of secondary school students towards mathematics based on gender.

1.2 Research Questions

To achieve the objectives of the study the following research questions guided the research.

1. What is the level of enjoyment students have for mathematics at the secondary level?
2. What is the level of anxiety and boredom among secondary school students when it comes to mathematics?
3. What is the level of perceived success in mathematics among secondary students?
4. Is there any difference in attitude towards mathematics among male and female students 'at secondary level?

2. Literature Review

Students' mental condition is the result of their life experiences, and their attitude may be shaped by their previous and current experiences. Some different but interconnected variables, for example background, motivation, and social support may provide clarification for student attitudes in math and understanding of those characteristics of attitudes in the environment of the school. Mathematical concepts are used in every branch of study and everyday life.

Understanding how students' attitudes and performance in mathematics are influenced by their perceptions of the topic is critical to ensuring that the subject is pleasant for all students. Another important factor is the relevance of mathematics to students' lives. When students can see the practical applications of mathematics, they are more likely to develop a positive attitude toward the subject (Santos-Trigo et al., 2021). Boaler (2019) argues that teaching which is engaging, challenging, and student-centered can help students develop a growth mindset and overcome barriers to learning, ultimately leading to greater accomplishment in mathematics.

The purpose of this study was to investigate students' attitude toward math at the secondary level and the elements that affect both their views and their performance. When it comes to choosing high school math courses, it is critical to understand the educational experiences and motivational processes that set the framework for students to pursue (or not pursue) careers in math-related fields (Wang & Degol, 2013). Many domain-related emotions, thoughts, and actions may be predicted using gender stereotypes. The lower a student's math performance, interest in math, and desire to pursue a career in math were, the more math was seen as a male domain by the student (Lane et al., 2012). There was an implicit stereotype of mathematicians as males among secondary school students as early as four years when they reached puberty, most pupils approved stereotypical views of mathematicians as being all-powerful and gifted men (Schmader, 2002).

Attitudes are the sentiments people have about themselves and the environment. Understanding how students influence their actions is a major focus of research in this area. Attitude may refer to beliefs, emotions, and behaviors for certain objects, persons, things, or events. Attitudes are often the result of experience or upbringing, and they can have a powerful influence over behavior. Ganley and Lubienski's (2016) study has shown that children's perceptions of their ability are more likely to be shaped by their socializers' opinions about their gender than by their preferences for certain domains. The aspects traditionally associated with men continue to be comparatively valued, according to these results regardless of gender differences which may change the results. Expectancy-value theory suggests that teachers' ideas and assumptions about gender differences in STEM-related self-concepts (mathematical ability) affect and form this perspective while attitudes are continuing, and may also change (Hand et al., 2017). Gunderson et al., (2012) noted that socializers like parents and teachers may have a substantial impact on the gender difference in school-based academic success and motivation. A teacher's opinion that females are better readers than boys projected a decrease in the boys' reading self-concept,

but girls' reading self-concept was unrelated to this belief (Retelsdorf et al., 2014. Representation of women in fields of science, technology, mathematics, and engineering has been linked to a belief in the requisite level of genius (Wang & Degol, 2016). Administrators and instructors may use teachers' academic success metrics, particularly the preparatory grades, to identify students who require remediation and help. There is a need to understand how the school environment influences kids' mathematics academic success to improve the school environment. Efforts might be made to improve the school atmosphere. According to Maskur et al., (2019) based on the outcomes of field trials and the objectives of the research, it might be concluded that the Aptitude Treatment Interaction (ATI) model has a greater impact on students' abilities of creative thinking than Problem-Based Learning model (PBL). According to the conclusions of the study, adopting learning models in combination with a PBL technique may result in the greatest outcomes for students. PBL models and ATI models may be integrated into several ways to conduct future research.

The ability to think creatively is getting more importance nowadays and quality education is an approach towards the improvement of creative thinking. An adequate learning model for training thinking might contribute to improving education. There are two learning models, and researchers are trying to establish which one is more effective in improving students' thinking skills. These learning models are Problem-Based Learning (PBL) and Aptitude Treatment Interaction (ATI) (Sumarni et al., 2019). The PBL learning model uses problems from the real world and contextualizes them for the students to enhance their skills of creative thinking and problem-solving (Hidayat et al., 2019).

According to Maskur et al. (2020), knowing in-depth details of students' attitudes toward mathematics and the factors that affect both their opinions and performance, is essential. The difference in the depiction of male students and female students in high-school mathematics is explained by cognitive differences based on gender. Due to their predisposition towards objects, male students are particularly well-suited to studying mechanical systems. It is impossible to correlate the discrepancies between male and female students' abilities and real competence differences. Student views, such as stereotypes and self-concepts about their abilities, are influenced directly by the ideas of socializers, according to the expectancy-value paradigm we focus on teachers' opinions because they are considered to have a greater impact on students' perceptions about their abilities (Ashcraft & Kirk, 2001).

There seems to be a wider gender discrepancy in the perceptions of one's abilities (or self-belief) and intrinsic motivation or interest and relevancy of math (Cvencek, Meltzoff & Greenwald, 2011). According to Wang and Degol, (2013)

most experts believe that gender discrepancies in math aptitude may not be a key reason that female students end up working in math more than male students. They may have a detrimental impact on higher education's diversity, according to past research. Women and minorities are frequently seen to lack an inherent aptitude for math because of their perceived lack of aptitude in the subject, and this perception has a detrimental effect on their self-esteem (Chestnut et al., 2018). It is the belief of the students that how well they can do on future or next tasks in different domains (i.e., their expectation of success in math) and how much they like, value, and enjoy the respective domain that are the most proximal pioneers of academic selections, with both constructs influenced by the child's skill of self-concept. Self-concept may be defined as the child's ideas of their competency in a certain area (arithmetic) and is the thought to be impacted by the opinions of the socializer and stable traits of the child i.e., gender and aptitude (Eccles & Wigfield, 2002). Male students have a higher aptitude for mathematics due to their spatial and numerical abilities. If a person wants to excel at mathematics, he may need to be a math person. This kind of thinking is typical in Western industrialized countries (Chestnut et al., 2018). Males have variability in their cognitive skills and abilities; therefore, they dominate the upper limit of mathematical talent. It was common for boys to outperform girls in places where this was true. According to Cvencek et al. (2018), The findings of comparable investigations using primary school samples of males and females were also found in different research. While the mean difference between girls and boys in arithmetic performance in early childhood tends to be nominal or nonexistent, greater gender disparities are discovered at the most advanced degree of ability (Brunner et al., 2008).

Research on cognitive growth in early school children, and students of all levels have not sufficient support for these claims. Instead, it provides evidence that scientific reasoning skill and mathematical skills develop from certain biological-based cognitive abilities that males and females share. These capacities provide a foundation to both men and women to develop equivalent talent in mathematics and science. Because male cognitive talents are more varied, they prevail at the top of the mathematical ability scale. These statements are not supported by research conducted on the cognitive development of humans and preschool children, along with students at any level. Instead, it shows that mathematical and scientific thinking are derived from biologically grounded cognitive abilities that are shared by both males and females. Not only men but women also gain equal skills in mathematics and science because of these abilities (Powell & Spelke, 2018). Several studies have found evidence to support the notion that the typical male has better arithmetic abilities and abilities than

the average female (Ertl et al., 2017). Opposite to this, the real mean difference between gender in arithmetic competency assessments is often minimal and frequently nonexistent (Else-Quest et al., 2010; Reilly et al. 2015). When it comes to the early years of research, the gender difference began to emerge at the top of performance distributions and expanded across the whole distribution in the initial years of elementary-level school (Cimpian et al., 2016). For example, comparing the results of the TIMSS and PIRLS tests, there were four girls and five boys at the higher performance level (Bergold et al., 2017). According to various empirical research, teachers' ideas about children's capacity for identity creation have an important influence. Evidence suggests that primary school teachers, like their male counterparts in math, have gender biases, furthermore, while comparing the arithmetic performance of girls to that of boys, they discovered a change in assessment criteria (Holder & Kessels, 2017). Learners' assumption that math is a "man" area seems to be supported or maintained by the teachers' transmission of stereotypical notions (Steffens et al., 2010).

3. Research Methodology

3.1 Research Design

This research was quantitative in nature. A cross-sectional survey design was used to study the secondary level students' attitude toward Mathematics. Moreover, descriptive surveys were used for the collection of data and to achieve the objectives.

3.2 Population and Sample

The population of this study consisted of 1562 secondary level students in government schools of Taxila. There was total 9 secondary schools in Tehsil Taxila. Total number of 9^{th} and 10^{th} grade students were 1562 in which 928 and 634 were boys and girls respectively. A sample of 368 students was drawn from 9 secondary schools of Punjab government of Taxila through random sampling technique. From 1560 students, 184 male and 184 female students were taken out using lottery method and later these students were accessed personally to collect data.

3.3 Instrumentation

Data were collected by using Mathematics Attitude Scale and a survey questionnaire. Mathematics Attitude Scale (short form) by Yasar (2014) was used to collect the response of students about attitude toward mathematics. This scale is based on four factors i.e., 1) Enjoyment 2) Fear, Anxiety and Distress 3) The use of Mathematics in everyday life 4) Perceived Mathematics Achievement. Data were collected through this instrument from the sample.

Table 1
Subscales of Mathematics Attitude Scale

Subscales	Total Items	Sample item
Enjoyment	6	1.I enjoy solving math problem whenever I see them.
Fear, Anxiety and Distress	5	9. I study math's only to pass the course.
The use of Mathematics in everyday life	4	12.I believe that the knowledge I get in math's class will be useful in life.
Perceived Mathematics Achievement	4	17.I see myself as a successful student in mathematics.

The scale consisted of four subscales and the details of number of items in each subscale and sample items is provided in table 1.

Table 2
Score Range for Levels of Mathematics Attitude

Score Range (mean score)				
1. Enjoyment (n=6)	2. Fear, Anxiety and Distress (n=5)	3. The use of Mathematics in everyday life (n=4)	4. Perceived Mathematics Achievement (n=4)	Level
6-12	5-10	4-8	4-8	Low
13-24	11-20	9-16	9-16	Medium
25-36	21-30	17-24	17-24	High

Table 2 shows the mean score for each dimension and the corresponding attitude levels.

4. Data Analysis and Interpretation

Descriptive statistics were used, and mean scores were obtained to define the range of observed scores under each dimension of the scale. Inferential statistics were computed for analyzing the collected data. Independent sample t-test was used for examining the effect of gender on the students' attitude towards mathematics at secondary level.

Table 3
Main Constructs of Mathematics Attitude Scale and their Scores

Main Constructs (Number of items)	M	SD
1. Enjoyment (n=6)	22.627 (Medium)	6.849
2. Fear, Anxiety and Distress (n=5)	16.847 (Medium)	5.918
3. The use of Mathematics in everyday life (n=4)	16.576 (Medium)	5.135
4. Perceived Mathematics Achievement (n=4)	16.005 (Medium)	3.687

Table 3 showed that level of students across all dimensions of scale is under the range of medium level hence showing at overall medium level of attitude among secondary level students towards mathematics.

Table 4

Gender-wise Mean Score Comparison of Secondary Level Students on Mathematics Attitude Scale

Scale	Gender	n	M	SD	F	t	df.	*p*
1.Enjoyment	Male	184	23.353	6.601	1.371	2.041	366	0.242
	Female	184	21.902	7.030				
2.Fear, Anxiety	Male	184	16.831	3.980	-0.053	366	0.994	0.000
3. Daily life	Female	184	16.864	5.871				
mathematics	Male	184	17.630	4.803	4.019	0.043	366	4.140
	Female	184	15.521	5.252				
4.Mathematics	Male	184	16.858	3.525	4.557	0.082	366	3.049
Achievement	Female	184	15.152	3.657				

Note. n= total number of students; M= mean; SD= Standard Deviation
Significance Level $p < 0.05$

An independent sample t-test was computed to compare the mean score of male and female secondary school students on the sub-scales of Mathematics Attitude Scale. It was found that on the subscale of "enjoyment" the mean scores of male students (M= 23.35, SD= 6.60) were higher than female (M=21.90, SD= 7.03). However, on the other factor (Fear, Anxiety) there was a significant difference in mean scores for Male (M= 16.83, SD= 3.98) and female (M=16.86, SD= 5.87). The female students scored higher than male students on this factor. There was no significant difference in mean scores on the factor of Daily life mathematics for Male (M= 17.63, SD= 4.80) and female (M=15.52, SD= 5.25). Lastly, there was found no significant difference in the mean scores on the factor of perceived mathematics achievement by male (M=16.85, SD= 3.52) and female (M=15.15, SD= 3.65) students.

5. Discussion and Conclusion

The study was designed to study the students' attitude towards mathematics at secondary level. There were further four factors in determining students' attitude towards mathematics. This was interesting to observe that overall male students scored better than female on three factors i.e., enjoyment, daily life mathematics and perceived mathematics achievement. However, male students scored less than females on the factor related to "Fear, Anxiety" towards mathematics. Several studies have also reported that there are gender differences in attitude towards mathematics with girls showing more negative attitudes than boys. In general, most of the studies reported that, in comparison with boys, girls lacked confidence, had unbearable causal attribution patterns, perceived

mathematics as a male domain, and were reported anxious about mathematics (Vermeer et al, 2000).

Opolot-Okurut (2005) found that for all the attitudinal variables (anxiety, confidence, and motivation), males had higher mean scores than females. However Meece (2003) stated that there is a meaningful difference between the attitude point mean values when the "gender" variable is considered. Mostly studies conducted on elementary school students reported the absence of gender differences regarding math anxiety scores (Chiu & Henry, 1990; Erturan & Jansen, 2015; Kucian et al., 2018; Ramirez et al., 2013; Schleepen & Van Mier, 2016; Young et al., 2012). In a longitudinal research study, students' anxiety level in mathematics and math performance was studied in boys and girls from grade 7 to grade 12 (Ma & Xu, 2004). However, the findings indicated that effects for math anxiety were found significantly stronger for girls than for boys, hence, mathematics anxiety varies from junior grades to high school girls. Hence, gender differences reported in previous research studies confirmed that these differences were observed during high school years (Liu et al., 2008; Lindberg et al., 2010).

Cimpian et al., (2016) have revealed that students' success in mathematics is associated with their positive attitudes towards mathematics hence directly proportional. Kogce et al. (2009) reported differences between younger and older students' attitudes towards mathematics with 8^{th} graders having lower attitudes than 6^{th} graders. According to research findings, when children first go to school, they usually have positive attitudes towards mathematics. However, as they move towards higher grades their attitudes become less positive and mostly become negative at high school.

The findings of the research of Ferguson et al., (2015); Jansen et al., (2016) and Miller & Bichsel, (2004) revealed that the gender differences regarding the high levels of math anxiety among female is higher than male students Based on report of. Ashcraft and Moore (2009) the females scores were found approximately 0.3 standard deviation (SD) higher than males on math anxiety scales from grade 6 through college and peaking at grade 9 and10. Van, Schleepen, and Van den Berg (2019) found the link between math anxiety and students' math performance in girls and emphasized the importance of the early identification of anxiety and remediation especially for girls to prevent long lasting effects.

Olatunde (2010) suggested that the process of learning depends not only on familial factors but also related with students' personal as well as psychological factors. The findings of this study also suggested conducting longitudinal studies on male and female students to examine more factors that

contribute towards increasing the level of anxiety among learners as they progress, and this may be helpful in eliminating the fear and anxiety about mathematics in learners.

6. Recommendations

Based on findings of the study, following recommendations are drawn.

1. Teachers may be trained to design problem-based activities and they may encourage students to use mental problem-solving strategies hence making mathematics more enjoyable subject.
2. Teachers may be trained to create a fun and enjoyable atmosphere in the mathematics classroom to decrease the element of fear and anxiety in mathematics classroom.

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