Role of Gender with respect to the Scale Attitude Towards Mathematics Inventory (ATMI) and its Dimensions

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Abstract: Mathematics is a subject that rules the day to day transactions of the world. It plays a significant role in the lives of people depending upon their attitude towards it. Various scales have been prepared by the researchers to measure the attitude of students towards mathematics. One such scale is Attitude Towards Mathematics Inventory (ATMI) prepared by Tapia and Marsh (2004). This tool has four dimensions namely: Self Confidence, Value, Enjoyment, and Motivation. The purpose of the present study is to analyze the role of gender with respect to the scale Attitude Towards Mathematics Inventory (ATMI) and its four dimensions. In order to compare the preference of boys and girls with regard to the subject mathematics, the researcher collected the data from 119 Secondary School boys and 109 secondary school girls (228). Mean, Standard Deviation and Standard Error is used under descriptive statistics and t-test is used under inferential statistics. The study is found to be insignificant in terms of the Scale ATMI and all its dimensions except the subscale Enjoyment where the result is found to be significant at α= 0.05 level. Based on the findings the educational implications are further discussed by the researcher.

Key words - Mathematics, Attitude, Attitude Towards Mathematics Inventory (ATMI), Dimensions of ATMI, Gender, Secondary School Students.

I. INTRODUCTION

Mathematics is an ancient discipline. Its origin is as old as human existence and has evolved with the human endeavor over a period of time taking on different skins, colours, shapes, and forms. The formal teaching and learning of mathematics can be traced back in the works of Sumerians that is 5000 years ago[1]. Today, in schools, students learn mathematics as a common subject right from their pre primary level of education to the secondary level of education and after it they have freewill to opt it as their specialized subject. The choice of pursuing their career in mathematics depends upon how they look at the subject. In simple words their attitude towards it.

Attitude refers to the feeling – like or dislikes someone or something based on the past experience(s). In general, the term attitude can be defined as a predisposition or a tendency to react positively or negatively towards stimuli that can either be a thought, idea, or concept[2]. Attitude in its multidimensional approach pertaining to the subject mathematics is defined as "an aggregated measure of a liking or disliking of Mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at Mathematics and a belief that Mathematics is useful or useless" (Ma & Kishor, 1997, 27)[10]. Students based on their experiences in school years carry positive or negative instincts about mathematics with them throughout their life. It is seen that students those who had experienced mathematics positively during their schooling are more inclined towards pursuing their career in mathematics and vice versa[9]. However, the statement attitude towards mathematics and mathematical attitude is distinguished by the research. The initial statement deals with the affective domain that takes the qualities like value, appraisal, and enjoyment into consideration whereas the later statement revolves around the cognition of human beings that deals with the mental openness, flexibility while seeking out the solution of an encountered problem, and reflective thinking[12]. Researchers over the ages have tried hard to study and understand the views students hold against mathematics to improve their academics.

A fleeting glimpse of the recent works on attitude towards mathematics can be seen below:

Kasimu and Imoro (2017)[7] study uncurtained no difference in the attitude of private and junior high schools students towards mathematics. The study was also found to be insignificant with respect to gender and with respect to private and public school.

Yasar (2015)[16] study yielded a difference in the attitude of students towards math classes, the educational level of their fathers and the school type. However, there was no difference found in the results pertaining to gender.

Kannan, Sivapragasam, and Senthilkumar (2015)[6] analysis showed self-finance and government-aided secondary school students comparatively have a better attitude towards mathematics than government secondary school students. The study proved to be significant with respect to gender. It is found that secondary school girls have a better attitude towards mathematics than their male counterpart. However, no difference was found in the urban and rural area and English and Telugu medium students of secondary school.
Sharma, and Puri (2014)[14] study showed that the class 10th grade students of the Polytechnic, Sikkim, carry the same attitude towards mathematics which means that they keep the same opinion about mathematics.

Marchis (2013)[10] results revealed a strong positive correlation between the attitude of students towards mathematics and their problem-solving skills. The results also showed an urgency of developing a positive attitude towards mathematics among pre-service primary school teacher.

Mata, Monteiro, and Peixoto (2012)[9] study indicated that generally, students' attitude towards mathematics is positive which is greatly supported by the grade and achievement of students in math. However, no gender difference is found in the study. It is observed that the

variables that are closely related with motivation act as the main predictors of attitude towards mathematics. Teachers and peers social support also play a significant role in understanding these attitudes.

Mutai (2010)[8] found in his study the lack of confidence and interest in secondary school students with respect to mathematics. Half of the percentage of his sample believed that they enjoy doing mathematics and in contrast to this the other half thought that mathematics classes are not so interesting. 49% of his sample was ready doing mathematics after the completion of their secondary school whereas the other 38% disagreed with the idea of pursuing mathematics after their schooling. However, the 70% of the respondents felt that mathematics has a great significance in the day to day life.

Tahar, Ismail, Zamani, and Adnan (2010)[15] found five criterion that influences the attitude of students towards mathematics. These criteria are interest, anxiety, self-efficacy, extrinsic motivation, and students' self-concept. The results obtained via data analysis explained 58.28% of total variation with 0.888 Cronbach's alpha reliability test.

The studies reviewed mostly proved to be insignificant in terms of gender. In view of this, the present study is taken up by the researcher to untangle the puzzle by finding out whether really gender doesn't play a significant role in studying mathematics? There are many tools prepared by the researchers to draw inferences about students' feelings or preferences towards mathematics like Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976), Attitudes to Mathematics Survey (White, Way, Perry & Southwell, 2005), Who and Mathematics (Brandell & Staberg, 2008) and Maths and Me Survey (Adelson & McCoach, 2009)[3]. One such scale is Attitude Towards Mathematics Inventory (ATMI) developed by Tapia and Marsh (2004).

In the present study, Attitude Towards Mathematics Inventory (ATMI) prepared by Tapia and Marsh (2004) is used by the researcher to know the role of gender played in terms of Mathematics which is done calculating the overall scores obtained by boys and girls of the scale Attitude Towards Mathematics Inventory (ATMI). This particular scale measures the attitude of students towards mathematics with respect to Self-confidence, Value, Enjoyment, and Motivation the four dimensions of the scale ATMI. Therefore, the researcher also made an attempt to analyze the role of gender with respect to these dimensions.

Research Objectives

- To study the role of gender with respect to the Scale Attitude Towards Mathematics Inventory.
- To study the role of gender with respect to the dimension Self-confidence of the Scale Attitude Towards Mathematics Inventory.
- To study the role of gender with respect to the dimension Value of the Scale Attitude Towards Mathematics Inventory.
- To study the role of gender with respect to the dimension Enjoyment of the Scale Attitude Towards Mathematics Inventory.
- To study the role of gender with respect to the dimension Motivation of the Scale Attitude Towards Mathematics Inventory.

II. RESEARCH HYPOTHESES

- There is no role of gender with respect to the Scale Attitude Towards Mathematics Inventory.
- There is no role of gender with respect to the dimension Self-confidence of the Scale Attitude Towards Mathematics Inventory.
- There is no role of gender with respect to the dimension Value of the Scale Attitude Towards Mathematics Inventory.
- There is no role of gender with respect to the dimension Enjoyment of the Scale Attitude Towards Mathematics Inventory.
- There is no role of gender with respect to the dimension Motivation of the Scale Attitude Towards Mathematics Inventory.

III. Research Methodology

The present work is a comparative study as it compares two groups that are boys and girls against the scale Attitude Towards Mathematics Inventory (ATMI), Tapia and Marsh (2004), and its four dimensions – Self Confidence, Value, Enjoyment, and Motivation. Based on the collected data the researcher compares the responses of the said two groups in order to draw out conclusions about their likeness of the subject mathematics.

3.1Population and Sample

All the Secondary School Students of Hyderabad, G.H.M.C. limits are taken as the population for the present study.

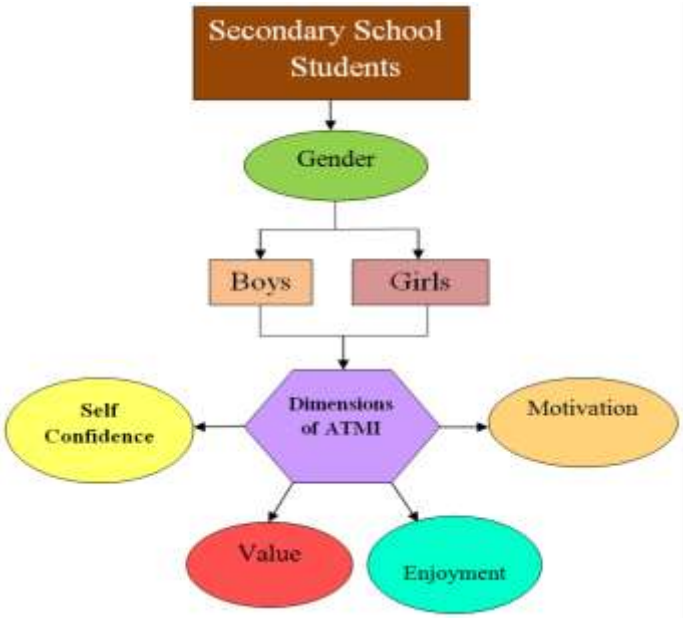
The sample of the present study is 228 (119 boys and 109 girls) secondary school students of Vidya Dayini Model High School (104), Hyderabad Islamic School (99), and Government Boys High School (25), Old City area, Hyderabad, Telangana.

3.2 Data and Sources of Data

The primary data is collected from the secondary school students of old city area – Vidya Dayini Model High School, Hyderabad Islamic School, and Government Boys High School.

The secondary data is collected from various e-journals via the internet that is cited in the reference section.

3.3 Theoretical framework



The present study is primarily concerned with the secondary school students of Hyderabad city only. It focuses on the role played by boys and girls in perceiving mathematics at the secondary school level. It tries to study whether boys are more inclined towards math or girls. For this purpose, the scale Attitude Towards Mathematics Inventory (ATMI) is used by the researcher which is prepared by Tapia and Marsh (2004). This particular scale has four dimensions- Self Confidence, Value, Enjoyment, and Motivation. The researcher compared the collected responses of boys and girls with respect to the scale ATMI. The scores are also compared dimension wise to see whether boys are more confident, value math, enjoy and are highly motivated while doing math than girls or vice versa.

Tool for Measurement

Attitude Towards Mathematics Inventory (ATMI), Tapia and Marsh (2004), contains 40 questions with four subscales:
(a) self-confidence, (b) value, (c) enjoyment, and (d) motivation[5].

Scale Description of Each Dimension of the Attitude Towards Mathematics Inventory (ATMI) Tapia and Marsh (2004)[5]**:**

- ***Self-confidence:*** It measures students' confidence and self-concept with respect to mathematics.
- ***Value:*** It deals with the feelings of anxiety and the consequence of these feelings.
- ***Enjoyment:*** It measures the extent to which students enjoy Mathematics classes.
- ***Motivation:*** It deals with the interest of students and desire to pursue mathematics in the future.

Reliability of the Tool

The Cronbach's alpha for the dimensions ranges from .88 – .97. The coefficient alpha of the overall instrument is 0.97 with a standard error of measurement 5.67 (Tapia & Marsh, 2004). The test-retest reliability for the dimensions ranges from .70 – .80. The test-retest reliability of the overall scale is .89[11].

validity of the Tool

Tapia and Marsh established content validity by relating items to the variables: confidence, anxiety, value, enjoyment, and motivation[13].

"Structure was explained by the four-factor model supporting different interpretations for students' self-confidence, value, enjoyment, and motivation as underlying dimensions of attitudes toward mathematics" (Tapia & Marsh, 1996, p. 16)[5].

Scoring of the Tool

The tool contains 40 items that are measured using a Likert scale with the following anchors: strongly disagree=1, disagree=2, neutral=3, agree=4, and strongly agree=5[13]. Twenty-nine items in the tool are positively arranged, for example, Mathematics is important in everyday life. There are 11 items that are negatively arranged like Mathematics is dull and boring. For negative items the scale is reversely scored where strongly disagree=5, disagree=4, neutral=3, agree=2, and strongly agree=1. The composite scores of respondents possibly range from 40 – 200[5].

The four subscales of ATMI – Value, Enjoyment, Self Confidence, and Motivation encompasses a different number of items like self-confidence deals with 15 items, value undertakes 10 items, enjoyment measures 10 items, and motivation assesses 5 items[4].

The distribution of the ATMI scale according to the four dimensions[4]**:**

Domain	Items	Total
Self-confidence	9,10,11,12,13,14,15,16,17,18,19,20,21,22,40	15
Value	1,2,4,5,6,7,8,35,36,39	10
Enjoyment	3,24,25,26,27,29,30,31,37,38	10
Motivation	23,28,32,33,34	5
Total		40

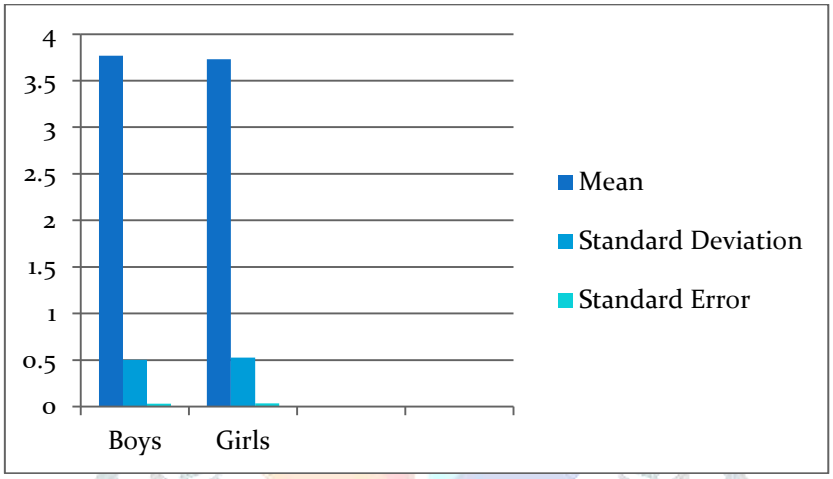
3.4Statistical tools and econometric models

Descriptive Statics is used to find out the mean, standard deviation, and standard error of the overall sample of the study with respect to the scale Attitude Towards Mathematics Inventory (ATMI). Then the mean, standard deviation, and standard error are separately calculated with respect to the dimensions of the scale ATMI – Self Confidence, Value, Enjoyment, and Motivation.

Independent sample t-test is used under inferential statistics to find out the significant difference between boys and girls at $\alpha 0.05$ level.

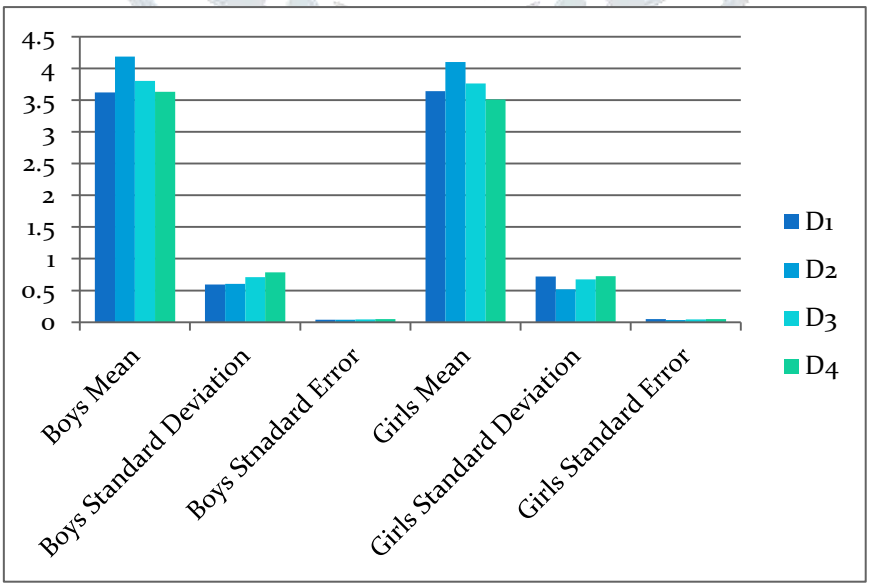
3.4.1 Descriptive Statistics

Graph 1: Descriptive Statistics of the scale Attitude Towards Mathematics Inventory with respect to Gender:



The Graph 1 represents the calculated Mean, Standard Deviation and Standard Error of Secondary School Boys and Girls with respect to the scale Attitude Towards Mathematics Inventory (ATMI).

Graph 2: Descriptive Statistics of the dimensions of the scale Attitude Towards Mathematics Inventory (ATMI) with respect to Gender:



Graph 2 represents the calculated Mean, Standard Deviation and Standard Error of Secondary School Boys and Girls with respect to the Dimensions of the scale Attitude Towards Mathematics Inventory (ATMI).

Table 1:
Hypothesis Testing I – Role of Gender with respect to the scale Attitude towards Mathematics Inventory (ATMI):

N	df	α	t cal	t cri	Sig
228	226	0.05	0.438	1.972	***H_o: Accepted***

Interpretation: There is no role of Gender with respect to the scale Attitude Towards Mathematics Inventory (ATMI) as the calculated t ratio is less than the critical t value for n= 228 df = 226 & α = 0.05.

Table 2:
Hypothesis Testing II – Role of Gender on the dimension Self Confidence of the Scale ATMI:

N	df	α	t cal	t cri	Sig
228	226	0.05	-0.192	1.972	***H_o: Accepted***

Interpretation: There is no role of gender on the dimension Self Confidence of the scale ATMI as the calculated t ratio is less than the critical t value for n= 228 df = 226 & α = 0.05.

Hypothesis Testing III – Role of Gender on the dimension Value of the Scale ATMI:

N	df	α	t cal	t cri	Sig
228	226	0.05	0.904	1.972	***H_o: Accepted***

Interpretation: There is no role of gender on the dimension Value of the scale ATMI as the calculated t ratio is less than the critical t value for n= 228 df = 226 & α = 0.05.

Hypothesis Testing IV – Role of Gender on the dimension Enjoyment of the Scale ATMI:

N	df	α	t cal	t cri	Sig
228	226	0.05	3.545	1.972	***H_o: Rejected***

Interpretation: There is a role of gender on the dimension Enjoyment of the scale ATMI as the calculated t ratio is greater than the critical t value for n= 228 df = 226 & α = 0.05.

Hypothesis Testing V – Role of Gender on the dimension Motivation of the Scale ATMI:

N	df	α	t cal	t cri	Sig
228	226	0.05	1.073	1.972	***H_o: Accepted***

Interpretation: There is no role of gender on the dimension Motivation of the scale ATMI as the calculated t ratio is less than the critical t value for n= 228 df = 226 & α = 0.05.

IV. Results and Discussion

The purpose of the present study was to analyze the role of gender with respect to the scale Attitude Towards Mathematics Inventory and its four dimensions – Self-confidence, Value, Enjoyment, and Motivation. The obtained results proved to be statistically insignificant at α= 0.05 level with respect to the scale ATMI and it's three dimensions that are Self Confidence, Value, and Motivation. However, the role of gender is found with respect to the dimension enjoyment where it is seen that boys enjoy the subject mathematics more than girls enjoy it. Therefore, it can be inferred from the study that boys, as well as girls, are equally inclined towards mathematics save the enjoyment angle where the boys found to enjoy the subject more than girls.

The measures that can be driven out from the study are:

- Math teachers of secondary schools can use the same teaching techniques for both boys and girls.
- The stakeholders especially the Math teachers should try their best to provide positive teaching-learning experiences that help students understand Math more conveniently.
- Teachers teaching Mathematics can also integrate problem-solving games like puzzles, riddles or can conduct quizzes that will stimulate the students towards learning Mathematics.
- Interactive teaching-learning experiences should be provided to the students that will help boost their self-confidence.
- Teachers should introduce the concepts of Mathematics in such a way that students should enjoy doing it rather than developing a fear of the subject.
- Teachers must be vigilant when it comes to students' self-concept and their anxiety towards Mathematics, they should motivate the students who are facing difficulty in solving a problem rather than using humiliating words that will tarnish their self-confidence, self-concept, and self-respect that may, in turn, create a lifetime barrier between a teacher and a student.
- Mathematics teachers can also adopt teaching techniques like peer coaching and peer tutoring to make students feel the value of the subject that will not only help them to understand Math in a better way but also enhance their problem-solving skills.

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