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Attitude Towards Mathematics and the Dimensions of Mathematics Anxiety: Do These Variables Differ Across Levels of Gender of Students, Family Income and Parent's Educational Level

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Abstract

Mathematics anxiety has warranted a great deal of research in the context of learning processes, classroom behavior and mathematics achievement, as well as exploration of possible effects of variable- attitude towards mathematics on mathematics anxiety Empirical studies are necessitated to explore how determinants like gender, family income and parent's educational level of students in higher education in India differ. The objective of this paper is to find whether there are significant differences of the determinants such as gender, family income and parent's educational level of the college students in India to attitude towards mathematics and bi-dimensional nature of mathematics anxiety. Two hundred forty students of higher education institutes in India (male-120, female-120) from diverse socio-economic background were randomly selected. The levels of the dependent variables – attitude towards mathematics, cognitive dimension of mathematics anxiety and the affective dimension of mathematics anxiety were determined. A multivariate analysis of variance (MANOVA) was conducted to determine whether multiple levels of the independent variables (gender, family income, and parent's educational level) on its own or in conjunction with one another influenced the dependent variables (attitude towards mathematics, cognitive dimension and affective dimension of mathematics anxiety).Data was collected (online) by using a survey form. The participants were selected by random sampling method from the students in higher education in India. The findings revealed that the independent variables-family income, parental educational qualifications and gender have non- significant difference to attitude towards mathematics, affective mathematics anxiety and cognitive mathematics anxiety.

Keywords: *Attitude towards mathematics, mathematics anxiety, cognitive, affective*

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I. INTRODUCTION

Mathematics is a core subject in the curricula of primary, secondary, higher secondary and tertiary education, and an understanding of mathematics has been linked with better occupational and economic prospects for an individual (Balagou & Koçak, 2006), and with an effective management of personal lives (Jain & Dowson, 2009).Given its importance to personal and societal well-being, mathematics achievement of individuals and the resultant anxiety-mathematics anxiety, have been a topic of interest for many researchers (Hembree, 1990; Lavasani, Hejazi & Varzaneh, 2011), specifically in the modern society oriented more and more towards data and technology.

Mathematics anxiety has been defined as 'feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations'. (Richardson & Suinn, 1972). Mathematics anxiety has warranted extensive research, because it has been observed(Punaro & Reeve, 2012) that mathematics elicited more anxiety as compared to the academic anxiety in other subjects. Most of the studies exploring the relationship between mathematics anxiety and other related constructs treated mathematics anxiety as an independent variable and mathematics achievement as the dependent variable. Dreger and Aiken (1957) made three assumptions about mathematics anxiety and its associations with related constructs. First they claimed that mathematics anxiety is distinct from general anxiety though related to it, secondly they assumed mathematics anxiety is not entirely dependent on general ability i.e. intelligence and thirdly they suggested a negative relationship between mathematics anxiety and mathematics achievement. Later, all the three predictions were proved by researchers (Hembree 1990, Ma, 1999).Though, the interrelationship between test anxiety and mathematics anxiety was not mentioned by Dreger and Aiken (1957), but empirical studies conducted by Dew (1984) report strong correlation between different mathematics assessment scores of mathematics anxiety than with test anxiety scores.

In 2002, Ashcraft suggested that mathematics anxiety encumbers cognitive processing in the brain by overburdening the working memory with unwanted thoughts. As a result, highly mathematics anxious students tend to avoid mathematical tasks, enroll for fewer mathematics electives in high school and college and make

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lower grades in mathematics (Hembree, 1990). In addition, these students appear to adopt a negative attitude towards the subject and have negative perceptions about their mathematical abilities which adversely affect mathematics competence and mathematics achievement, particularly observed in case of female college students (Faust & Ashcraft, 1994; Malinsky et al, 2006).

Antecedents to mathematics anxiety

Halmos(1984) and Schoenfeld (1992) stated mathematics anxiety depends on certain factors that are intrinsic to the subject, for e.g., accumulative nature of mathematics, heavy reliance on mathematical symbols and signs, and manipulations of symbols, problem-solving, understanding of complex mathematical concepts, and others. Deficits in necessary arithmetic skills (Nunez-Pena et al., 2014), poor mathematical competence has also been found to intensify mathematics anxiety. Therefore, mathematics anxiety as a construct has warranted a great deal of research in the context of learning processes (Tobias, 1983; Ansari & Derakshan, 2010; Cowden, 2010), classroom behavior (Younger, Schneider, & Guirguis-Younger, 2008) and mathematics achievement (Ashcraft, 2002). Though, the detrimental effect of mathematics anxiety on performance is a proven fact, but the mechanism by which it hampers performance is inconclusive.

Jain and Dowson (2009) described that mathematics anxiety is a consequence of "an inability to handle frustration, excessive school absences, poor self-concept, internalized negative parental and teacher attitudes toward mathematics, and an emphasis on learning mathematics through drill without "real" understanding" (p. 240). Devine and his colleagues (2012) systematically grouped the variables that act as antecedents to mathematics anxiety into three classes namely, environmental variables, intellectual variables and personality variables. Environmental variables include classroom experiences, teacher and parental characteristics and external factors like expectations. Intellectual variables are related to students' cognitive abilities whereas personality variables include self-constructs like self-efficacy, confidence, attitude towards mathematics related tasks such as those faced when working with computer , statistics and learning behaviour.

Bi-dimensional nature of MA

Researchers (Bandalos et al., 1995; Meece, Wigfield, & Eccles, 1990) found that mathematics anxiety is bi-dimensional – cognitive dimension and affective dimension. While the affective factor correlate significantly but, negatively with mathematics achievement (Wigfield & Meece, 1988) and children's perceptions expectations (Prawat & Anderson,1994), the cognitive factor of mathematics anxiety correlate positively with the importance that children attach to mathematics as well with their ratings of effort expended in mathematics. In a cross-cultural study, group of researchers (Ho, et al, 2000) posited that the dimensions of mathematics anxiety can be distinctly identified in the sixth –grade students samples collected from the United States, Taiwan and China. They reported that the affective factor of mathematics anxiety incapacities mathematics performance more than the cognitive dimension. The distinctive effects of the affective and cognitive components on performance have implications on the intervention strategies that can be formulated to minimise mathematics anxiety.

Gender and MA

A line of studies on mathematics anxiety explored gender differences and reported inconsistent findings. While majority of these studies revealed that the females have higher levels of mathematics anxiety compared to their male counterparts (Alexander & Martray, 1989; Khatoon & Mahmood, 2010; Malinsky, Ross, Pannells & McJunkin, 2006), some other studies(Haynes, Mullins &Stein, 2004) indicated non-significant gender differences in mathematics anxiety. Haynes et al (2004) posited that there were various other factors related to the males' and females' mathematics anxiety and so gender differences should be evaluated in isolation. They reported that mathematics anxiety of male students were significantly affected by general test anxiety, while the levels of females' mathematics anxiety were strongly related to several factors like perceptions of teachers' mathematics ability, their perceived mathematics ability and general text anxiety. Also, Baloglu &Koçak (2006) found that gender effects of mathematics anxiety varied with the context and that gender affects mathematics anxiety in conjunction with other factors (Wigfield & Meece,1988).These authors acknowledged that female students expressed negative reactions towards mathematics, which explained the differences in the mathematics avoidance behaviour of males and females, and triggered mathematics anxiety later on, in college. Woodard (2004) further revealed that female college students' mathematics anxiety did not adversely affect their mathematics performance, or cause avoidance behavior, and did not develop more negative attitude towards mathematics. Miller & Bichsel (2004) suggested that gender acts as a moderator between the relationship between mathematics anxiety and mathematics performance. From these results, it is not clear whether there is a difference in the effects of mathematics anxiety between male and female students specifically in college.

Therefore, more research on gender differences on the dimensions of mathematics anxiety is required to gain better insights into female students' mathematics anxiety as they transit from early grades to college. One of the aims of this study is to test the proposition that there are no significant gender differences in the cognitive dimension and affective dimension of mathematics anxiety of students in higher education in India.

Attitude towards mathematics

Attitude has been considered as a cognitive guide that might favour or inhibit learning (Gomez-Chacon, 2000) .Furthermore, Vazquez, et al (2001) considered attitude to be a factor that explains acceptance or rejection of mathematics. The attitude towards mathematics has been defined as an aggregated measure of "a liking or disliking of mathematics, a tendency to engage in or avoid mathematics activities, a belief that one is good or bad at mathematics and a belief that mathematics is useful or useless" (Neale, 1969, p. 623). Several factors affect attitude towards mathematics, namely 1) student related factors– their mathematics performance

scores(Kögce et al, 2009), students' mathematics anxiety, students' mathematics self-efficacy and self-concept,extrinsic motivation (Tahar et al, 2010) and experiences at high school (Klein, 2004);2) factors related to teacher, teaching and school -teacher's content knowledge, teaching methods, teachers" beliefs towards mathematics (Carter & Norwood, 2010) and teachers" attitude toward mathematics and c) factors related to home environment and society-namely,parent's educational background, occupation and parental expectations (Tobias, 1993).Researchers(Betz, 1978;Wigfield& Meece, 1988; Meece, Wigfield & Eccles, 1990; Pajares & Miller, 1994) have reported that positive attitude towards mathematics is negatively related to mathematics anxiety.

Studies examining gender differences on attitude towards mathematics report inconsistent findings. On one hand, there are studies that demonstrate no significant gender differences in attitude towards mathematics (Kögce et al, 2009; Nicolaidou & Philippou, 2003) and on the other hand, there are some other studies that report significant difference in attitude towards mathematics in the male and female students in the third year college students (Grootenber & Lowrie, 2002).The lack of consensus and consistency in the results of the empirical studies suggest that students' attitude towards mathematics are very subjective. Hence, in this study we will explore whether gender differences on attitude towards mathematics is present in the context of the college students in India. Thus, we will test the proposition that attitude towards mathematics does not differ depending on gender of students in higher education in India.

Parent's socio- economic status

In most studies, socio-economic status has been defined as a combination of parental and family variables like- family income, family size, parent's educational level (Mayer & Jencks, 1989). Campbell (1992) found that parents directly and significantly affect children's' attitude towards mathematics and indirectly affect students' mathematics anxiety. Gumus (1997) observed that variables related to family and parents affect mathematics anxiety. Although, several researchers (Yenilmez & Özbey, 2006; Ari et al. 2010,&Mahigir et al. 2012) claimed that there is a significant relation between these demographic variables and mathematics anxiety and attitude towards mathematics, contradictory findings have also been observed. Vukovic (2013) reported that parental educational levels do not impact children's mathematics anxiety. In literature, there is a general consensus that mathematics anxiety is low for students from high income background, but other researchers (Mahigir et al., 2012) reported that family income is not an anxiety affecting variable.

Most of these empirical studies have explored the effects of the demographic variables on students' mathematics anxiety and attitude towards mathematics, particularly of secondary and high school students. There is still a lack of studies examining the factors affecting students' attitude towards mathematics, and mathematics anxiety (cognitive and affective dimension), specifically in the higher education level in India. In this regard, an investigation into the impact of the socio- economic variables such as, gender, family income, and parent's educational level on the students' mathematics anxiety and attitude towards mathematics, particularly of higher education in India, is necessitated. This raises the following research questions.

What differences are caused in attitude towards mathematics and bi-dimensional mathematics anxiety of students of higher education in India, by gender, family income and parent's educational level? What are the interactions among the independent variables? What is the strength of association between the dimensions of mathematics anxiety and attitude towards mathematics?

Hence, in this paper we scrutinise the multivariate effects of determinants such as gender, parent's educational level, and family monthly income, to the attitude toward mathematics, and the dimensions of mathematics anxiety of college students in India by testing the following hypotheses.

H1: There are no significant gender differences in the cognitive dimension and affective dimension of mathematics anxiety of students in higher education in India.

H2: The cognitive dimension of mathematics anxiety does not differ across levels of the treatment variable-family income.

H3: The cognitive dimension of mathematics anxiety does not differ across levels of the treatment variable-- parent's educational qualification.

H4: The affective dimension of mathematics anxiety does not differ across levels of the treatment variable-family income.

H5: The affective dimension of mathematics anxiety does not differ across levels of the treatment variable-- parent's educational qualification.

H6: Attitude towards mathematics does not differ depending on gender of students in higher education in India.

H7: Attitude towards mathematics does not differ across levels of the treatment variable-family income.

H8: Attitude towards mathematics does not differ across levels of the treatment variable- parent's educational qualification.

In addition, we determine the level of the three dependent variables namely, attitude toward mathematics, and the dimensions of mathematics anxiety.

II. RESEARCH METHODS

Research Design: The current study is a quantitative study, employing causal comparative research design. In a causal comparative research, "the researchers attempts to determine the causes or the effects of the differences that already exist between or among the groups of individuals" (Fraeknel, 2011, pg. 366) .As the researcher has no control on the independent variable the relationship between the independent variable and the dependent variable is a proposed relationship (Fraeknel, et al, 2006) and the findings are open to various causal explanations. This design provides evidence of the differences and the level of significance of variables as well as the statistical analysis of the influence attributed by the independent variables to the dependent variables. In this study, the researchers determined how the independent variables (gender, family income and parent's

educational level) influence the dependent variables (attitude towards mathematics and mathematics anxiety).

Sampling design: A random sampling technique was used for selecting the participants of the study; a technique in which the researcher selects a subset of the population randomly such that each sample can be selected with equal probability. The participants of this study were the students studying in various programs in higher education institutions in India – Bachelor of Science, Bachelor of Engineering, Master of Science, Post graduate programs in applied sciences, etc. All the participants had opted for at least one mathematics course in the current phase of their studies. A total of two hundred eighty seven students participated in the study, of which a subset of two hundred forty responses were retained after deleting those responses which had missing information.

Data collection process: Data was collected in online mode, by sharing a survey form with the participants of the study. This survey was prepared by the researchers after modifying existing scales to suit the objectives of the present study.

There were two instruments employed to gather data for the current study – attitude towards mathematics questionnaire adopted from Nicolidau and Philippou (2003)and mathematics anxiety questionnaire adopted from Bursal and Paznokas (2006).The coefficient of Chronbach's alpha a was calculated to measure the internal consistencyattitude towards mathematics and the mathematics anxiety questionnaires- reporting Chronbach's alpha value of 0.892 and 0.870respectively. The instruments - attitude towards mathematics consisted 15 items with five responses using 5-point Likert scale (1- strongly disagree, 5- strongly agree) and mathematics anxiety comprised of 26 items with seven responses using a 7-point Likert scale (1-strongly disagree, 7-strongly agree).These instruments included demographic variables- gender, age, family income, family size, parent's educational levels, and language spoken.

Data analysis: The statistical analysis of the data was done by determining the mean, standard deviation,Box's M, Levene's test and Multivariate Analysis of Variance (MANOVA).The composite scores (mean) of the Likert scale data obtained for attitude towards mathematics and mathematics anxiety were computed, and were analysed at the interval measurement scale(Boone (2012).For the interval measurement scales mean and standard deviation are suggested measures of central tendency and variability respectively.Levene's testfor all three dependent variables ,ATM, MAA and MAV are non-significant (significance greater than .05) and Box's M test for equality of the covariance matrices shows a non-significant value(.200),indicating no significant difference between the groups on the three dependent variables,Finally, MANOVA was conducted to determine whether the response variables (attitude towards mathematics and mathematics anxiety), are altered by the independent variables (gender, family income and parent' educational level).The operational definition of the variables in the statistical analysis of the study are as follows.

- Mathematics anxiety (MAA) – The affective dimension associated with mathematics anxiety that explains the emotional component of anxiety, feelings of nervousness, tension, dread, fear and unpleasant physiological reactions to testing situations(Liebert and Morris ,1967) Mathematics anxiety (MAC) -The cognitive dimension associated with mathematics anxiety that explains the 'worry' part of anxiety, displayed through negative expectation, pre-occupation with and self-deprecatory thoughts about an anxiety –causing situation(Liebert and Morris ,1967)
- Attitude towards mathematics (ATM)- A belief that one is good or bad at mathematics and a belief that mathematics is useful or useless.

III. RESULTS AND DISCUSSION

Level of attitude towards mathematics and mathematics anxiety of students in higher education in India

Table 1 shows the students' level of attitudes towards mathematics and the dimensions of mathematics anxiety. Students' attitude towards mathematics waslabelled as 'neutral' whereas both the cognitive and affective dimensions were described as 'somewhat true'. The neutral attitude towards mathematics has implications both on their enthusiasm for mathematics and mathematics achievement. Students with a positive attitude expend more time for solving both routine and non-routine mathematical problems, and try out methods not used by their teachers. As already mentioned, attitudes are formed primarily at individual homes, influenced by parents and teachers, specifically in the case of younger children. In college students, such findings have not been reported.

Table 1:Level of Attitude towards mathematics , cognitive and affective dimension of mathematics anxiety

Dependent variables	N	Minimum	Maximum	Mean	Std. Deviation	Qualitative description
ATM	240	1.40	5.00	3.4525	.60712	Neutral
MAA	240	2.00	6.46	4.1087	.88302	Somewhat agree
MAC	240	1.38	6.54	3.9583	.89999	Somewhat agree
Valid N (list wise)	240					

In previous studies, attitude has also been linked to the emotional well-being of a person. Positive attitude towards mathematics (Dowker et al, 2016;Akin, 2011) has been reported to correlate with negative mathematics anxiety, which implies that there is a significant relationship between the affective dimension rather than the cognitive dimension of mathematics anxiety.

The mean values of cognitive and the affective dimensions of mathematics anxiety (MAC and MAA) are 4.1 and 3.9 respectively, this data supports the findings ((Rounds & Hendel, 1980) that students are disposed to worrying, when they think about mathematical tasks and feel nervous when they are involved in a mathematical tasks –mathematics problem solving, during classroom instructions and specifically when they are evaluated. The results are in consonance with the study of Ho et al, (2000) which reported that more than the cognitive dimension of mathematics anxiety, the affective factor impacts mathematics achievement negatively. Thus, the findings of this paper, is useful for developing intervention strategies to minimise mathematics anxiety, and improve mathematics performance.

Also, teachers should use instructional strategies that facilitate a positive attitude towards mathematics, thereby reducing mathematics anxiety and alleviating mathematics achievement.

Multivariate tests for group differences across groups in gender

In Table 2. the descriptive statistics of the three dependent variables- ATM, MAA and MAC for all groups of gender is displayed.

Table 2:Descriptive statistics of ATM, MAA and MAC for all groups of Gender

			ATM	MAA	MAC
GENDER	Male	Mean	3.5016	4.0625	3.9067
		N	120	120	120
		Std. Deviation	.63948	.86046	.91797
	Female	Mean	3.4034	4.1548	4.0099
		N	120	120	120
		Std. Deviation	.57138	.90626	.88246
Total		Mean	3.4525	4.1087	3.9583
		N	240	240	240
		Std. Deviation	.60712	.88302	.89999

Table 2 revealed that the mean scores of the three dependent variables vary across the two groups – namely, male and female students. The difference in the mean scores (4.1548-4.0625 = 0.923) was highest for affective mathematics anxiety (MAA) with a higher mean score of females as compared to the male students. But, when a MANOVA was conducted, the differences between the groups were not found to be significant on MAA (p value=0.419) .Table 3 reflects the summary of the MANOVA across the levels of gender. The p –values of MAC (0.376) and ATM (0.211) - indicate that there are no significant differences in gender on cognitive mathematics anxiety and affective mathematics anxiety as well.

Table 3:Summary of MANOVA across gender

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	ATM	.579	1	.579	1.574	.211	.007
	MAA	.511	1	.511	.655	.419	.003
	MAC	.639	1	.639	.788	.376	.003
Intercept	ATM	2860.687	1	2860.687	7779.822	.000	.970
	MAA	4051.449	1	4051.449	5188.525	.000	.956
	MAC	3760.417	1	3760.417	4638.466	.000	.951
GENDER	ATM	.579	1	.579	1.574	.211	.007
	MAA	.511	1	.511	.655	.419	.003
	MAC	.639	1	.639	.788	.376	.003
Error	ATM	87.514	238	.368			
	MAA	185.842	238	.781			
	MAC	192.947	238	.811			
Total	ATM	2948.780	240				
	MAA	4237.802	240				
	MAC	3954.003	240				
Corrected Total	ATM	88.093	239				
	MAA	186.353	239				
	MAC	193.586	239				

This datum showed that the students' gender does not directly affect their attitude towards mathematics. Hence, the p-value implies that the attitude towards mathematics does not differ significantly on gender of students in higher education in India, which supports Kögce et al, (2009) and Nicolaidou & Philippou, (2003) findings.

The results also indicate that there are no significant gender differences (p-values of .419 and .376) on cognitive mathematics anxiety and affective mathematics anxiety. Mullins & Stein, (2004) had indicated non-significant gender differences in mathematics anxiety which is supported by the results in Table 2. There is no significant direct effect of the gender of the college students in India on mathematics anxiety; so male and female students display same level of mathematics anxiety. The findings of this study do not support the notion that females express higher levels of mathematics anxiety than the male counterparts in the higher education in India. Again, the results imply that both males and females possess similar attitude towards mathematics, hence, teachers should focus on the instructional strategies, classroom environment and discourse that do not differentiate between the genders of the students.

Multivariate tests for group differences across groups in family income

In Table. 4, the average scores of the three groups in family income – low income (1), middle income (2) and higher income (3) are exhibited. The mean score values of the three groups on ATM increase as the level of family income increase whereas the results of the average scores of MAA and MAC across the three groups neither increase nor decrease.

Table 4: Descriptive statistics of ATM, MAA and MAC for all groups of Income

			ATM	MAA	MAC
INCOME	1	Mean	3.4087	4.0599	3.9273
		N	138	138	138
		Std. Deviation	.62471	.87718	.87005
	2	Mean	3.4839	4.1790	4.0084
		N	55	55	55
		Std. Deviation	.46567	.87061	.88674
	3	Mean	3.5442	4.1694	3.9910
		N	47	47	47
		Std. Deviation	.69474	.92355	1.01187
Total		Mean	3.4525	4.1087	3.9583
		N	240	240	240
		Std. Deviation	.60712	.88302	.89999

For ATM, the difference of low income versus middle income group is .0752 and middle income versus higher income is 0.1355.To examine and assess the extent to which these differences are significantly different, a MANOVA was conducted the result of which is displayed in Table 5.

Table 5: Summary of MANOVA across family income							
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	ATM	.714	2	.357	.969	.381	.008
	MAA	.773	2	.387	.494	.611	.004
	MAC	.321	2	.161	.197	.821	.002
Intercept	ATM	2332.243	1	2332.243	6325.833	.000	.964
	MAA	3296.596	1	3296.596	4210.018	.000	.947
	MAC	3045.617	1	3045.617	3734.826	.000	.940
INCOME	ATM	.714	2	.357	.969	.381	.008
	MAA	.773	2	.387	.494	.611	.004
	MAC	.321	2	.161	.197	.821	.002
Error	ATM	87.378	237	.369			
	MAA	185.580	237	.783			
	MAC	193.265	237	.815			
Total	ATM	2948.780	240				
	MAA	4237.802	240				
	MAC	3954.003	240				
Corrected Total	ATM	88.093	239				
	MAA	186.353	239				
	MAC	193.586	239				

The multivariate test examines the significance of differences across the three groups of family income on the three dependent variables -ATM, MAA and MAC. The p-values indicate that the differences in the mean scores on the three dependent variables are not significant. This result supports earlier findings of Mahigir et al., (2012), that family income neither influences attitude towards mathematics nor triggers mathematics anxiety in students in higher education in India. This suggests that there are several other factors- that impact college student's attitude towards mathematics, and mathematics anxiety. As mathematics becomes more important in higher education than in school, for pursuing technology related courses and lucrative careers hence, students at the tertiary level are more motivated to expend more time in learning mathematics irrespective of the levels offamily income. Family income as a socio-economic variable does not contribute towards attitude towards mathematics as well as mathematics anxiety of college students in India.

Multivariate test according to parent's educational qualification:

Parent's educational qualification variables- mother's educational qualification (PAREDU1) and father's educational qualification (PAREDU2) have four groups- high school diploma (1), graduate (2), postgraduate (3) and doctorate (4).Table 6 summarises the mean scores of the four groups on the three dependent variables, ATM, MAA and MAC.

Table 6: Descriptive statistics of ATM, MAA and MAC for all groups of father's educational qualification(PAREDU1) and mother's educational qualification(PAREDU2)				
		ATM	MAA	MAC
PAREDU1 1	Mean	3.3807	4.2416	4.1013
	N	82	82	82
	Std. Deviation	.58439	.87531	.84821
2	Mean	3.4781	3.9505	3.8028
	N	87	87	87
	Std. Deviation	.56470	.85209	.82962
3	Mean	3.5281	4.0404	3.9167
	N	60	60	60
	Std. Deviation	.70731	.88089	1.01055
4	Mean	3.3724	4.7413	4.3497
	N	11	11	11
	Std. Deviation	.50940	.88111	1.01475
Total	Mean	3.4525	4.1087	3.9583
	N	240	240	240
	Std. Deviation	.60712	.88302	.89999
PAREDU2 1	Mean	3.3224	4.1573	4.0205
	N	77	77	77
	Std. Deviation	.55292	.87928	.96224
2	Mean	3.4877	4.0889	3.9797
	N	87	87	87
	Std. Deviation	.64586	.90260	.82761
3	Mean	3.6175	4.0950	3.8612
	N	64	64	64
	Std. Deviation	.57684	.84008	.87445
4	Mean	3.1515	4.0128	3.9231
	N	12	12	12
	Std. Deviation	.58629	1.07584	1.17487
Total	Mean	3.4525	4.1087	3.9583
	N	240	240	240
	Std. Deviation	.60712	.88302	.89999

From the results, the average scores of the first three groups of both PAREDU1 and PAREDU2 increases, while there is no such trend in case of the other two dependent variables (MAA, MAC).In this sample, 240 respondents are almost evenly split across the first three groups of PAREDU1 and PAREDU2 (1,2,3) with sample sizes of 82,87 and 60 . These sample sizes in concurrence with the three dependent variables go beyond the guidelines (Hair, Babin & Black, 2015) to detect medium effect sizes (44 to 56), but are lesser than the required sample size (98 to 125) to categorize small effect sizes with a power of 0.80.

Table 7: Summary of MANOVA across parent's educational qualification							
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	ATM	4.811	14	.344	.928	.529	.055
	MAA	13.428	14	.959	1.248	.242	.072
	MAC	9.771	14	.698	.854	.609	.050
Intercept	ATM	608.271	1	608.271	1643.358	.000	.880
	MAA	920.384	1	920.384	1197.548	.000	.842
	MAC	838.758	1	838.758	1026.688	.000	.820
PAREDU1	ATM	.041	3	.014	.036	.991	.000
	MAA	6.914	3	2.305	2.999	.031	.038
	MAC	3.374	3	1.125	1.377	.251	.018
PAREDU2	ATM	2.880	3	.960	2.594	.053	.033
	MAA	1.291	3	.430	.560	.642	.007
	MAC	.846	3	.282	.345	.793	.005
PAREDU1 * PAREDU2	ATM	.542	8	.068	.183	.993	.006
	MAA	3.378	8	.422	.549	.818	.019
	MAC	2.799	8	.350	.428	.903	.015
Error	ATM	83.281	225	.370			
	MAA	172.925	225	.769			
	MAC	183.815	225	.817			
Total	ATM	2948.780	240				
	MAA	4237.802	240				
	MAC	3954.003	240				
Corrected Total	ATM	88.093	239				
	MAA	186.353	239				
	MAC	193.586	239				
a. R Squared = .055 (Adjusted R Squared = -.004)							
b. R Squared = .072 (Adjusted R Squared = .014)							
c. R Squared = .050 (Adjusted R Squared = -.009)							

Table. 7displaythe test of significant difference by parental qualifications across the three dependent variables. The p-values indicate that there is no significant difference between parents' educational level in terms of attitudes toward statistics, and cognitive dimension of mathematics anxiety.

Multivariate effects of gender, family income and parents' educational qualification:

The MANOVA results using Wilk's Lambda in Table 8 shows that gender was not significant with Wilk's Lambda = 0.968, F (3,183) = 1.988, p > .001, multivariate ?2 = 0.032. The value of F is not significant indicating that there were no significant differences among the gender (male or female) groups on the three dependent variables.

Table 8: Multivariate analysis of demographic profiles

Independent variable	Wilks' Lambda	F	Hypothesis df	Error df	Significance	Partial eta squared
GENDER	.968	1.988	3	183	.117	.032
INCOME	.964	1.115	6	366	.353	.018
PAREDU1	.949	1.070	9	445.525	.384	.017
PAREDU 2	.912	1.912	9	445.525	.049	.030

As mentioned before, Mahagir et al(2012) found parents' educational status affected children's attitude towards mathematics as well as mathematics anxiety, specifically observed in a sample of schoolchildren. The findings of this study reports a non- significant relationship between mathematics anxiety (affective dimension) with parents' educational qualification in the context of college students, at F (9,445.525) =1.070, Wilk's lambda-.949, p>.001, multivariate ?2= 0.017 for PAREDU1 and F(9,445.525)=1.912, Wilk's lambda-.912, p>.001, multivariate ?2 = 0.030for PAREDU2.The demographic variable , family income was not significant with Wilk's Lambda = 0.968, F (6,366) = 1.115, p > .001, multivariate ?2 = 0.018.

IV. CONCLUSION

Based on the findings of this study, the following conclusions were drawn. The level of students' attitude towards mathematics was reported as 'neutral',which suggests that the students were not certain about whether they liked mathematics and as a result of which were unable to decide whether to spend more time to learn mathematics or not. Additionally, the level of mathematics anxiety was reported 'somewhat agree', suggesting that the students in higher education in India were found to express anxiety to some degree when doing mathematics. Furthermore, the students appear to worry about their engagement with mathematics, when they think about taking mathematics examination, attending a mathematics class and also when solving problems. Next, the demographic variables gender, family income and parents' educational qualifications were found to have non-significant relationship with attitude towards mathematics, and both the dimensions of mathematics anxiety. This implies that these variables do not impact attitude towards mathematics and have no effect on their mathematics anxiety. Lastly, due to the limited studies in India, future studies might take into consideration, morecolleges in the sampling to provide and establish strong statistical analysis and solid evidence of thedeterminants that significantly affect attitude towards mathematics and mathematics anxiety of college students. Further research should be done in order to confirm or refute the findings of this study.

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