

The Role of Parental Math Attitude in Their Children Math Achievement

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Abstract Mathematics as a subject is imperative for excelling in any field of study and it acts as glue that connects various disciplines together. The crucial variable determining achievement in mathematics is the attitude towards mathematics. The foremost purpose of the present study was to investigate whether children's math attitude serves as an underlying pathway between parental math attitude and their children's math achievement. A total of 482 students (251 females and 231 males) of the age ranging from 10 to 15 years (5th to 10th grade) and one of their parents (mother/ father) participated in the study. Parents and their wards math attitude was measured using attitude towards mathematics. Mathematics achievement test was constructed for each grade level based on their current curriculum. The Mediation analysis was carried out. It was found that father's math attitude contributes positively to their son's math attitude and math achievement as compared to mother's math attitude. On the contrary, mother's math attitude positively influences their daughter's math attitude and math achievement in comparison with father's math attitude.

Keywords Parental Math Attitude, Children's Math Attitude, Children's Math Achievement and Mediation model

1. Introduction

Mathematics skill has been identified as one of the key competence necessary for employability in the modern society. Mathematics is used as an essential tool in several fields including natural science, engineering, medicine and social sciences throughout the world. For several decades, student's poor performance and maths avoidance remains a significant challenge for education community. However, schools have tried to keep a pace by stiffening their mathematics requirement. This has resulted in a disparity between those who learn math with relative ease and those who struggle for it.

In today's fast growing technology, the demand for people who can think in terms of math has grown exponentially. Researchers have proposed varying definitions of attitudes towards Mathematics (ATM). [1] defines attitude as "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" (p. 632). [2] proposed a wider definition of ATM 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" (p. 27).

Attitude towards mathematics has been considered as the primary variable determining achievement in mathematics [3]. Teacher's attitude and beliefs, teaching style and behaviour, parent attitudes and beliefs, affects the student's attitude towards mathematics. It has been observed that both parental and children math attitude play an important role in children math achievement. The present study is an attempt to understand whether math attitude serves as an underlying pathway in the relationship between parental math attitude and their children's math achievement.

2. Parental Role and Children Math Achievement

There is a substantial influence of parents on their children's educational aspirations and it is much stronger than that of peers [4]. Studies have shown that the parents who are knowledgeable, aware and more involved with their wards, bring up their children having a more positive school attitude and a better academic performance (Epstein, 1992, as cited in Anthony & Walshaw, 2007) [5]. According to [6] parental involvement has a direct impact on student's academic achievement. Children's attitude towards mathematics is affected by their home environment [7]. The home environment comprises of various motivational variables, but the most relevant one involves the parents [8]. Mathematics achievement is affected by children's attributes and behaviours, which is primarily influenced by parental involvement. [9]

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3. Parental Math Attitude

Student's achievement in mathematics and their participation in advanced level mathematics is a reflection of their parents attitudes and aspirations [10]. Parents presumption about children's math ability forecast children's self-perception in math, despite the children's own past math achievement and this self-perception about math affects their subsequent math achievement [11, 12]. Enormous researches have reinforced the significance of parents attitudes in persuading their adolescents' attitudes and achievement [11]. According to [13] the sole factor in children's educational success is their parents and their attitudes towards learning. However, it seems that many parents are more actively involved in their children's language learning than mathematics [14].

4. The Present Study

Previous studies have shown the role of parents in positively influencing their adolescents' achievement and also their achievement-related beliefs and attitudes [15]. According to [16] found that teachers' attitude towards the teaching of mathematics plays a major role in shaping the attitude of students towards learning of mathematics. There is a positive role of mathematics teachers' in enhancing students' participation in classroom activities through teaching styles, quality of teaching and classroom assessment [17] There is a significant relationship between learning environment and attitude towards mathematics [18].

This study is designed to extend the literature by examining whether math attitude serves as an underlying pathway in the relation between parental math attitude and their children's math achievement. In addition to this, the goal of our study is to formulate a mediation model in order to explain a differential impact of father's and mother's math attitude on their children's math achievement and math attitude.

An attempt was made to test the models shown in the following tables, which made four predictions. First, we hypothesized that son's math attitude serves as an underlying pathway between father's math attitude and son's math achievement. Second, we hypothesized that daughter's math attitude serves as an underlying pathway between father's math attitude and daughter's math achievement. Third, we predicted that son's math attitude serves as an underlying pathway between mother's math attitude and son's math achievement. Lastly, we hypothesized that daughter's math attitude serves as an underlying pathway between mother's math attitude and daughter's math achievement.

Mediation analyses are employed to understand a known relationship by exploring the underlying mechanism or process by which one variable (X) influences another variable (Y) through a mediator (M). In the present paper, (Father's / Mother's Math attitude, X) influences another variables (Son's / Daughter's Math Attitude, Y) through a mediator i.e (Son's/ Daughter Math Achievement).

5. Methodology

The sample comprised of four hundred and eighty two students (251 females and 231 male) studying in 5th-10th grade in a school and also included one of the parents (father/mother) of each student. The sample was drawn from Patiala Sahodhya School Complex, which is a cluster of CBSE affiliated schools in and around Patiala district (Punjab). It mainly covers the following districts of South-West Punjab i.e Patiala, Rajpura, Nabha, Samana and Govindgarh.

Participants were selected through a two stage selection process. Initially, from the CBSE schools of Punjab, thirty eight Sahodhya schools were randomly selected (these thirty eight schools belong to various districts of Punjab). Then from each district 10% schools were selected through random sampling. Firstly, permission was sought from the principal of respective schools for conducting the study. The school authorities were asked to provide the enrolment list of their 5th to 10th grade students, out of which 100 school students were selected by means of stratified sampling from each of the school.

Then, informed consent form was sent to parents for seeking permission from them to conduct study on their wards. Only those children whose parents gave consent participated in the study. From the selected students, 482 students participated by completing the questionnaire.

6. Measures

(a) Attitude towards Mathematics Inventory ATMI (Tapia, 1996)

The scale was developed by [19]. The inventory consisted of 40 statements regarding students' perceptions about their own math ability, value, enjoyment and relevance of math in their everyday lives. The Cronbachs' alpha of this measure for my sample is .81.

The lowest possible total score would be 40, indicating negative attitude towards mathematics and highest score being 200 assuming positive attitude towards mathematics.

(b) Math Achievement Test

Math achievement test comprised of two parts: In part one, children's math score in school final examination was taken and in second part, math achievement test was constructed for each grade.

According to Central Board of Secondary Education norms, for each subject there is a CCE criteria (Continuous Comprehensive Evaluation) on the basis of which the students' marks are awarded. There are 2 main parts of an assessment, (i) Formative Assessment (FA), (ii) Summative Assessment (SA).

Formative Assessment involves internal assessment for 40 marks comprising of quizzes, assignments and projects. This constitutes 40 marks.

The Summative Assessment is based on marks obtained in two examinations conducted in December and March. Each

exam carries 90 marks of which ($1/3^{\text{rd}}$ is taken i.e 30 each = 60 marks) derive the final score.

Therefore, the total score i.e. Formative Assessment (40 marks) and Summative Assessment (60 marks). For my study I have taken 80% of 100.

In part two, math achievement test was constructed for each grade level to evaluate children's math achievement. It comprised of 20 questions based on the current math curriculum and all the questions were approved by the 10 experts of mathematics. Inter rater reliability of the math achievement test came out to be .80. Finally a composite score of Math Achievement was taken into consideration by adding these two math scores (Marks Obtained in Final Examination + Marks obtained in Math Achievement Tests). There exist a strong positive relationship between math score in final examination and math achievement test ($r = 0.78$, $p < 0.001$).

The primary components for studying the math achievement of students of 5th to 7th grade were Algebraic expression, Data handling, Geometry and Bar graph. This involves basic mathematical skill which deals with the basics of mathematics. For students of 8th to 10th grade basic components involves Statistics and Probability, Comparing quantities, Mensuration, Number system, Exponents and powers. It consists of some elements that are involved in higher mathematics.

7. Procedure

The researcher approached various schools of Patiala Sahodhya School Complex and explained the purpose of the study to the authorities, who then assisted in the process of data collection. Firstly, the consent letter was sent to the parents for seeking permission to allow their wards to be part of the study. After the informed consent was signed by parents their children were provided with the questionnaire and were tested for math attitude and math achievement. Similarly, information was gathered from parents by sending them math attitude inventory. The subjects were tested on these dimensions with the measures mentioned earlier. The scoring was carried out according to the standardized manuals of the respective tests. The data was analysed using SPSS (20.0 version) and AMOS (20.0 version) and results were interpreted in the light of mediation model.

8. Results

We conducted mediation analyses and used bootstrapping method to examine a differential impact of father's and mother's math attitude on their son's and daughter's math achievement and math attitude. We used the AMOS 20.0 to run the analyses. The following tables summarize the results.

As shown in **Table 1**, the effect of Father's math attitude and son's math attitude "path a" was statistically significant, which was necessary for mediation analyses to proceed.

When we held Father's math attitude constant, the effect of son's math attitude on their math achievement "path b" was also significant. However, when son's math attitude was held constant, the direct effect of Father's math attitude "path c'" was not statistically significant for son's math achievement, indicating that son's math attitude fully mediated the relationship.

Table 1. Illustration of Mediation Analysis (Bootstrap Methods) for Fathers Math Attitude and Sons Math Achievement

Path/effect	Bootstrap Results		
	B	SE	p
c (F MAtt → S M Ach)	.56	.04	.001
a (F M Att → S M Att)	.82	.04	.001
b (S M Att → S M Ach)	.45	.09	.001
c'	.16	.09	.06

Note: N= 126, F M Att = Fathers Math Attitude, S M Ach = Sons Math Achievement and S M Att = Sons Math Attitude

The effect of Father's math attitude and daughter's math attitude "path a" was statistically significant as presented in **Table 2**. A significant effect was evident between daughter's math attitude on their math achievement "path b". However, the direct effect of Father's math attitude "path c'" was insignificant for daughter's math achievement, signifying that daughter's math attitude fully mediated the relationship.

Table 2. Illustration of Mediation Analysis (Bootstrap Methods) for Fathers Math Attitude and Daughters Math Achievement

Path/effect	Bootstrap Results		
	B	SE	p
c (F MAtt → D M Ach)	.47	.04	.001
a (F M Att → D M Att)	.72	.07	.001
b (D M Att → D M Ach)	.48	.04	.001
c'	.13	.04	.002

Note: N= 127, F M Att = Fathers Math Attitude, D M Ach = Daughters Math Achievement and D M Attitude = Daughters Math Attitude

As depicted **Table 3**, the effect of Mother's math attitude and son's math attitude "path a" was significant. Similarly, "path b" depicts a statistically significant effect of son's math attitude on their math achievement. However, son's math attitude fully mediated the relationship between Mother's math attitude and their math achievement as "path c'" was not statistically significant.

Table 3. Illustration of Mediation Analysis (Bootstrap Methods) for Mothers Math Attitude and Sons Math Achievement

Path/effect	Bootstrap Results		
	B	SE	p
c (M MAtt → S M Ach)	.44	.05	.001
a (M M Att → S M Att)	.89	.07	.001
b (S M Att → S M Ach)	.31	.07	.001
c'	.16	.07	.03

Note: N=105, M M Att = Mothers Math Attitude, S M Ach = Sons Math Achievement and S M Att = Sons Math Attitude

The effect of Mother's math attitude and daughter's math attitude "path a" was statistically significant as depicted in **Table 4**. When Mother's math attitude was held constant, the

effect of daughter's math attitude on their math achievement "path b" was significant. However, the direct effect of Mother's math attitude "path c'" was insignificant for daughter's math achievement, signifying that daughter's math attitude fully mediated the relationship.

Table 4. Illustration of Mediation Analysis (Bootstrap Methods) for Mothers Math Attitude and Daughters Math Achievement

Path/effect	Bootstrap Results		
	B	SE	p
c (M MAtt → D M Ach)	.87	.08	.001
a (M M Att → D M Att)	1.19	.08	.001
b (D M Att → D M Ach)	.46	.08	.001
c'	.34	.12	.006

Note: N=, M M Att = Mothers Math Attitude, D M Ach = Daughters Math Achievement and D M Att = Daughters Math Attitude

9. Discussion

The primary purpose of the present study was to investigate whether the children's math attitude succour as an underlying pathway in the relationship between parental math attitude and their children's math achievement. The results of our study suggest a pathway from parental math attitude to their children's math attitude and math achievement. To begin with, we found that father's math attitude has a differential influence on their son's and daughter's math attitude and their math achievement. Father's math attitude positively influences their son's math attitude and math achievement as compared to their daughter's math attitude and their math achievement. Mediation analysis proved the relationship between a father's math attitude and son's math achievement as mediated by son's math attitude. The major reason could be the father's viewpoint about his son's expertise in math and the belief that his son will undoubtedly excel in mathematics. This result is consistent with [20] according to which parents rate the significance of math greater for boys and also assumes that boys have natural talent in maths and they will also have greater future success in careers requiring math skills than girls.

When the impact of mother's math attitude was taken into account, a comparison was drawn between son's and daughter's math attitude and math achievement. It was found that mother's math attitude positively influences their daughter's math attitude and math achievement as compared to son's math attitude and math achievement. In the Indian context, the findings can be explained in terms of emotional attachment and physical proximity of daughters and their mothers. This finding further supports the notion that the mother's acknowledgement for children's success *intervene* the relation between child gender and mother's belief of their child's ability [20].

Evidently, when a comparison was drawn between father's and mother's math attitude on their son's and daughter's, a differential impact on their son's and

daughter's math attitude and math achievement was observed. It was found that the father's math attitude contributes more positively to their son's math attitude and math achievement as compared to mother's math attitude. This finding is further backed up by the study that parents of students in middle and high school, tend to believe that boys have higher math ability than girls and also expect them to achieve more than girls [24, 25]. On the contrary, mother's math attitude positively contributes to their daughter's math attitude and math achievement as compared to the father's math attitude. The mediation model proved the relationship between the mother's math attitude and the daughter's math achievement as mediated by the daughter's math attitude. However, in the context of daughters, their math attitude serves as an underlying pathway in the relationship between mother's math attitude and their math achievement. Parents presumption about children's math ability forecast children's self-perception in math despite the children's own past math achievement and this self-perception about math affects their subsequent math achievement [11, 12].

Parents have immense influence over their children in the area of academic performance and career orientation. This study further contributes to the body of research documenting a relationship between parental involvement and their children's math achievement. According to [21] the parenting styles and engrossment leads to academic achievement of their wards. [22] suggests that children's academic achievement is a result of parental involvement.

Thus, it can be inferred from the present study that parents serve as an consistent role model for their children as their behaviour is closely observed by their wards. Parents induce positive attitude towards mathematics in their children by considering it a valuable subject. It is proved through mediation models that the independent variable (i.e., parental math attitude) causes the mediator (i.e., children's math attitude) and that the mediator causes the dependent variable (i.e., math achievement).

10. Implications and Conclusions

The results drawn from this research have significant implications for educators, policy makers, teachers, parents and school counsellors. It is quite evident from the study that parents play a major role in the academic achievement of their children. Parents need to be aware about their own emotional state and attitude while dealing with children in their academic matters. The kinds of interaction parents have with their children and the identifiable patterns of caretaking greatly affect their children's academic performance. Both mother and father play an equally important role in shaping the personality and overall development of a child. Moreover by discovering the factors which influence students math anxiety and math attitude, educators can help students to be successful in mathematics by removing the bottlenecks such as fearful and negative attitude of their students.

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