Effect of Mathematics Anxiety on Punjab Public Secondary School Students' Mathematics Achievement

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ABSTRACT

The study investigated the effect of mathematics anxiety on the mathematics achievement of the public secondary schools' students of district Faisalabad, Punjab, Pakistan. The present study was descriptive (survey type) in its nature and quantitative by approach. All the students of public secondary schools of district Faisalabad constituted the target population. A sample of 300 students was drawn using multistage cluster random sampling technique. Pearson product-moment correlation coefficient (r) and simple linear regression were used as inferential statistics to analyze the data. A moderate inverse correlation was investigated between mathematics anxiety and students' academic achievement. Through simple linear regression, 33% variation was noted due to mathematics anxiety in students' academic achievement.

Introduction

Mathematics anxiety is a condition of nervousness, fear, tension, or uneasiness created when learners perform mathematical operations (Cemen, 1987). Mathematics anxiety is considered as one of the major issues among pedagogues (educationist), and it negatively affects students' learning and their academic achievement. According to Tobias (1995), mathematics anxiety is referred to as a sensation of nervousness and tension which interferes with the manipulation of numbers to solve mathematical sums in a different style than routine work and can cause learners to forget the solution of mathematical problems and have a lack of self-efficacy; and they feel insecure in such situations. Consequently,

learners' earlier unsupportive experiences regarding mathematical problems in classroom and home are frequently transferred continuously and act as significant hindrances in comprehending the mathematical operations and facts inductively. Mathematics anxiety is a state of fear and helplessness which an individual faces when he is asked to perform certain mathematical operations (Bursal & Paznokas, 2006).

Mathematics anxiety is a painful sensation of fear or tension which hinders and reduces students' mathematics achievement and has two factors i.e. cognitive and emotional (Ashcraft, 2002; Cemen, 1987). The cognitive factors involve apprehensions of a student's performance, mistrust, lack of confidence, and negative attitude (Cemen, 1987) and sentimental elements include uneasiness, nervousness, fear, dread, and distress during working with numbers (Morris, Davis & Hutchings, 1981).

According to Reyes et al. (2007), mathematics anxiety is a construct that has become a center of discussion and interest for many investigators since the late 1970s. The need of the hour is that the present day mathematics curriculum should be prepared on practical basis and also the students' mathematical needs should be pertinent to their daily life accordingly; and students have to be engaged in thinking, analyzing, elaborating and exploring new ideas instead of engaging only in memorizing mathematical operations, procedures and rules. Cooperative Learning Groups (CLGs) offer learners an opportunity to negotiate ideas, freely ask questions and find solutions, to explain and elaborate mathematical problems to each other, to elucidate thoughts and perceptions in a meaningful way and to articulate insight regarding their learning process. Such skills can be attained in the early age and, are significantly valuable during their professional lives (Spikell, 1993).

A number of researches have been carried out to investigate the relationship between mathematics anxiety in secondary schools' students and their achievement score in mathematics. The findings of these studies indicate that mathematics anxiety significantly affects students' mathematics achievement at secondary level (Bhatnagar & Saxena, 2000).

Mathematics anxiety is a very serious issue regarding students' mathematics achievement, and it occurs due to teachers, parents and peers creating nervousness and fear among students. The students feel that mathematics is a complicated major and they are incapable to

understand mathematical problems, consequently learners want to escape from such situations (Puteh, 2002). In the same vein, teachers' lack of knowledge regarding individual differences among students and different learning styles also contribute to students' mathematics anxiety. Therefore, educators must adopt student centered methodologies which could match with students' individual needs and also of the whole class (Scarpello, 2007).

According to Rameli et al. (2014), mathematics is an integral part of every student's life and influences every aspect of human activities. To lessen the intensity of mathematics anxiety among learners, it is indispensable for the educators to minimize the negative effects of mathematics anxiety during the mathematics teaching and examination in the class so that the learners do not perceive any negative feeling about mathematics.

Mathematics anxiety affects students' mathematics achievement through the cognitive interference experienced by the students. Therefore, students' find it hard to retrieve concepts which they have already memorized or learned. They are incapable of giving accurate answers or solutions of mathematical problems in the exams and hence, end up with poor academic achievement (Schwarzer & Jerusalem, 1992).

A number of studies regarding students' mathematics anxiety indicate that there is a moderate negative correlation between mathematics anxiety and students' achievement score. Simply, it is concluded by the results of the studies that an increase in students' mathematics anxiety decrease their academic achievement in mathematics (Furner & Berman, 2004; Hardfield et al., 1992; Satake & Amato, 1995; Woodard, 2004). Also, a higher degree of mathematics anxiety is negatively correlated with lower level of students' academic achievement (Quilter & Harper, 1988).

In a study conducted by Preis and Biggs (2001), researchers argued that psychological and physical symptoms of mathematics anxiety among learners include: i) inability to focus on a specific task, ii) overwhelming negative self-talk, iii) sweaty palms, iv) heart palpitations, v) memory loss, vi) fear of failure, vii) headache, viii) muscle tension, ix) Nausea, x) shortness-of-breath, and xi) increased blood pressure. Such symptoms and many other harmful experiences regarding mathematics may lead students to a "vicious cycle" in which anxiety and dread of mathematics meddled with mathematics' learning that takes the learners

to more depressing mathematics experiences. This cycle leads learners to restrict their engagement in mathematics courses that further limits their academic achievement.
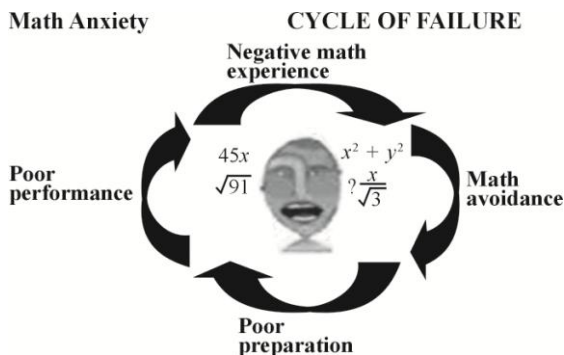
Figure 1. Vicious Cycle Regarding Students' Mathematics Failure (Preis & Biggs, 2001)

According to Tobias (1978), several other possible sources of mathematics anxiety including inadequate preparation, misunderstanding the mathematical language, distrust of insight, and the notion of mathematics as an "exact science."

Objectives of the Study

The following objectives guided the study:

1. To find out the relationship between mathematics anxiety and students' achievement in mathematics;

2. To determine the effect of mathematics anxiety on students' achievement in mathematics.

Research Questions

Consistent with the objectives, the study was driven by following research questions:

1. Is there any relationship between mathematics anxiety and students' achievement in mathematics?

2. Is there any effect of mathematics anxiety on students' achievement in mathematics?

Delimitations

Having limited time and resources, the study was conducted only in one district of the province, Punjab, Pakistan.

Methodology

Research Design

The present study employed a descriptive survey approach. A cross sectional survey was adopted to collect the data regarding mathematics anxiety and students' achievement scores.

Population of the Study

All the students in public secondary schools of the province Punjab, Pakistan were the target population of the study. The students enrolled in public secondary schools in the district Faisalabad were the accessible population of the study.

Sample of the Study

A sample of 300 students was drawn through simple random sampling technique from the students of the public secondary schools of the district Faisalabad. The schools were drawn on convenient basis, however the selection of the students was made on the basis of random sampling.

Instrument of the Study

The research instrument Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ) developed by May (2009) was adapted to measure the level of mathematics anxiety. MSEAQ has two subscales including self-efficacy (SA) and mathematics anxiety (MA), however, only one subscale "MA" was taken to measure students' level of MA. A questionnaire having 16 items regarding MA was taken from the MSEAQ on a five point Likert type rating scale (1 = Never to 5 = Always).

The magnitude of Cronbach's Alpha was 0.84. The instrument was translated from English into Urdu since it was difficult for Grade 9 students to understand the questions in English language. However, in

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order to ensure the validity of the translation, the translated version was examined by the experts. Students' scores in mathematics in Grade 9 examination of BISE (Board of Intermediate and Secondary Education) Faisalabad, were used as a measure of students' mathematics achievement scores.

Data Analysis Techniques

Pearson product-moment coefficient of correlation (r) and simple linear regression were used to analyze the results of the research from the sample.

Findings

Research Question 1: Is there any relationship between mathematics anxiety and students' academic achievement?

Pearson's r correlation coefficient was applied to explore relationship between MA and students' academic achievement.

Table 1

Relationship between Mathematics Anxiety and Students' Achievement in Mathematics

Variables	N	*r*	*p*
Mathematics Anxiety & Students' Academic Achievement	300	-.57	.000

[***]*p<.001, df =298*

The Pearson product-moment coefficient of correlation (r) was used to explore the relationship between mathematics anxiety and students' achievement in mathematics. The above table demonstrates a moderate negative relationship between mathematics' anxiety and students' academic achievement; $r(298) = -.57$, $p<.001$. Therefore, it was found that there is a statistically significant negative relationship between mathematics anxiety and students' mathematics achievement.

Research Question 2: Is there any effect of mathematics anxiety on students' achievement in mathematics?

Simple linear regression statistical technique was applied to explore significant effect of mathematics anxiety level on students' achievement

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in mathematics.

Table 2

Descriptive Statistics on Mathematics Anxiety and Students' Academic Achievement

Variables	N	M	SD
Mathematics Anxiety	300	2.173	.8748
Students' Achievement in Mathematics	300	46.82	16.142

Table 3

Regression Model Summary Regarding the Effect of Mathematics Anxiety on Students' Achievement in Mathematics

R	R-Square	Adjusted R-Square	Std. Error of the Estimate	df	F	p
.571	.326	.324	13.271	1	144.312	.000

[***]$p<.001$

Table 3 shows that there is a highly significant effect of mathematics anxiety on students' achievement in mathematics at secondary school level.

Table 4

Regression Coefficients of Mathematics Anxiety and Students' Achievement in Mathematics

Model	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
Achievement Score in Mathematics	69.715	2.054		33.935	.000
Mathematics Anxiety	-10.540	.877	-.571	-12.013	.000

[***]$p<.001$

To investigate the level of the effect of mathematics anxiety on students' achievement in mathematics, simple linear regression statistical technique was used, and results are reported in Tables 2 and 3

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respectively.

The results of Table 2 report that the value of F-ratio supports the predictive utility of MA on students' achievement in mathematics, because the magnitudes of R-square=.326, adjusted R-square = .324, & F = 144.312 with df =1, which all are highly significant at $p< 0.001$ (Table 3). The magnitude of R-square = .326 indicates that there is as much as 33% variations in students' mathematics achievement being accounted for by the variations in mathematics anxiety.

Table 4 informs regarding non-standardized coefficients for mathematics anxiety and students' score on achievement in mathematics. Mathematics anxiety $\beta^\wedge$ = -10.540, t= -12.013 at $p<.001$ was found to be highly significant to students' achievement in mathematics. Therefore, it was concluded from the above result that mathematics anxiety had a significant effect on mathematics achievement score of students. Also, the value of standardized beta (Beta = -.571) reflects a moderate negative relationship between predictor and criterion variables (see Table 4).

The coefficient for Mathematics anxiety is -10.540 (see Table 4). So for every unit increase in math anxiety, a -10.540 unit decrease in mathematics achievement score is predicted, holding all other variables constant. Also, the effect of mathematics anxiety on students' academic achievement can be determined through the prediction equation, which is described as: $Y = a+bX$

Where Y stands for achievement score which is dependent variable, X represents mathematics anxiety which is an independent variable, 'a' is intercept (constant) and 'b' is the slope of regression line. If mean mathematics anxiety is 2.173 (see Table 2), then mathematics achievement score of the student can be calculated through simple linear regression equation. Here, the magnitude of Intercept is 69.715, and the slope is -10.540. Therefore, the achievement score in mathematics of the students were calculated as:

Achievement Score = 69.715-10.540 (Mathematics Anxiety Mean Score)
in Mathematics

$$= 69.715-10.540(2.173)$$
$$= 69.715-22.903$$
$$= 46.271$$

Therefore, it can be concluded from the above calculations that achievement score in mathematics of students becomes 46.271 on average. This score is highly significant at $p<.001$ (Table 4).

A significant moderate negative relationship was found between mathematics anxiety and students' achievement in mathematics. These findings also corroborated the findings of Hardfield et al. (1992), Satake and Amato (1995), Woodard (2004), and Furner and Berman (2004), who argued that Mathematics anxiety and students' achievement are inversely associated with each other. Also, a significant effect of mathematics anxiety on students' achievement score in mathematics was discovered through simple linear regression statistical technique. This finding is consistent with the finding of Zakaria and Nordin (2008).

This significant relationship and causation may be due to the discrepancy of parents' educational level, students' educational backgrounds, the use of traditional teaching methodology for the instruction of mathematics, availability of facilities in public schools, and students' attitude towards mathematics.

Recommendations

It is proposed that Punjab Education Department (PED) should conduct refresher courses and workshops on new research-based teaching strategies and practices for the development of teaching and learning skills regarding mathematics at the secondary level.

It is also suggested that teachers should use following techniques for mitigation of students' mathematics anxiety: i) develop positive relationship with students; ii) use a variety of students' assessment techniques including direct observation, oral questioning, discussion and retesting with a prior test on daily or weekly basis; and iii) facilitate students immediately after diagnosing their shortcomings and weaknesses.

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