A Study of Creativity in Mathematics in Relation to Mathematical Anxiety among Adolescents

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Abstract

This Research paper highlighted the relationship between the mathematical creativity and the mathematical anxiety among the adolescents. The nature of the investigation was descriptive survey method. The study was conducted on a sample drawn from the 10th grade secondary school students of Punjab State. 200 students from the Government secondary schools affiliated to P.S.E.B. Mohali were selected by the technique of multistage randomization. Data was collected by the 1. Mathematical Creativity test (2012) by Sharma and Sansanwal to assess mathematical creativity of students. 2. Mathematical Creativity test (2012) by Sharma and Sansanwal to assess mathematical creativity of students. Data was analysed statistically and found that 1. Thus there is no significance difference in the creativity in mathematics of rural and urban adolescents. 2. there exist significant positive relation between mathematical anxiety and mathematical creativity for scheduled caste students.3. there exist significant positive relation between mathematical anxiety and mathematical creativity for rural adolescents.

KEYWORDS : mathematical creativity , mathematical anxiety

Introduction :

Mathematics is an important subject in secondary schools because it is associated with more academic and career opportunities. The history of human civilization reveals the necessity of counting, measuring, weighing and drawing in all aspects of environment. Mathematics has not become important only today but it occupied and kept this important place from the earlier times and is perhaps the only subject which merits this destination.

MATHEMATICS

Anyone can be a mathematician mostly people do not agree with this. But, I insist that anyone with average intelligence if properly guided can master the science of mathematics.

The history of human civilization reveals the necessity of counting, measuring, weighing and drawing in all aspects of environment. Mathematics is an integral part of the world, and its every aspect is quantitative.

Mathematics has not become important only today but it occupied and kept this important place from the earlier times and is perhaps the only subject which merits this destination.

MATHEMATICAL CREATIVITY

If we try to sense the mathematical creativity from the above nature of creativity we can conclude mathematical creativity as to making new mathematical combinations from existing mathematical concepts, objects and elements.

Poyla (1957) defined mathematical Creativity as the ability to solve problems requiring independence, judgment, originality and creativity.

Torrance (1962) expressed mathematical creativity as the process of sensing problems in mathematical fields, searching for solutions, making guesses about them and finally communicating results.

According to Laycock (1970) Creative mathematics is the ability to analyse a given problem in many ways, observe patterns, see likeness and differences and on the basis of what has worked in similar situations to decide on a method of attack in unfamiliar situation.

Jensen (1973) defined mathematical creativity as the ability to give numerous, different and applicable responses when presented with a mathematical situation in written, graphic, or chart form.

Krutetski (1976) Mathematical creativity can be manifested in five different ways: (a) through problem posing, (b) using alternative methods, (c) by inventing proofs, by generating formulas and (d) creating unique methods to solve mathematical problems.

Singh (1988) defined mathematical creativity as the process of formulating hypotheses concerning cause and effect in a mathematical situation, testing and retesting these hypotheses and making modifications and finally communicating the results.

Haylock (1997) have applied the concept of fluency, flexibility and originality to the concept of creativity in mathematics.

MATHEMATICAL ANXIETY:

Mathematical anxiety is a psychological factor that influences achievement in mathematics. Many students who are weak in mathematics worry while attempting to use maths skills to solve problems. Due to the presence of mathematics anxiety, students will try to escape from any situation that involves mathematics. If students perceive that mathematics is difficult during their earlier years, mathematics anxiety will be triggered.

Richardson and Suinn (1972) described mathematical anxiety as feeling of tension and anxiety that impair the ability to manipulate numbers and solve mathematical problems in a wide variety of ordinary life and academic situations.

Hendel and Davis (1978) conceptualized mathematics anxiety as an effective response that includes avoidance of mathematics, subsequent failure to learn mathematics skills, and thus negative career and school-related decisions.

Kogelman and Warren (1978) described mathematical test anxiety as an adverse reaction to mathematics.

Cemen (1987) Mathematics anxiety can be defined as a state of discomfort created when students are required to perform mathematical tasks.

Byrd (1982) described it as any situation where one experiences anxiety "when confronted with mathematics in any way.

Handler (1990) stated that mathematics anxiety represents an anxious state induced by fear of failing when attempting to learn or to demonstrate one's learning of mathematics and she implied that mathematics anxiety may result in a high level of emotional interference that can disrupt memory.

Ailly & Bergering,(1992) fear and apprehension to specific math-related situations.

Tobias (1993) characterized math anxious individuals as those who mistrust their problem solving abilities and experience a high level of stress when called upon to use those abilities, particularly in public.

REVIEW OF RELATED LITERATURE:

CREATIVITY IN MATHEMATICS

Jensen (1973) studied the relationships between mathematical creativity, numerical aptitude and mathematical achievement in relation to computation and problem solving. He found moderately high correlation among the constructs and recommended that the possibility of mathematical creativity as a supplementary evidence of a student's Mathematics performance.

Noorjehan (2009) studied factors affecting academic achievement of IX standard students in mathematics and found that factors like mathematical creativity, attitude towards mathematics, achievement motivation and a low level of anxiety influenced the academic achievement in mathematics at secondary stage and recommend the inclusion of curricular and co-curricular programmes to improve performance in mathematics.

Bahar (2011) studied the relationship between student's creative performance and achievement in mathematical domain across grade levels. They discovered that maths assessment was used to measure originality, flexibility and elaboration, fluency and total mathematical creativity as indexes of student's mathematical creativity. Using Pearson correlation, they found significant relationship among all the measures of creativity (fluency, flexibility and elaboration).

Walia (2012) conducted a study to examine the relationship of mathematical creativity with achievement and difference between boys and girls with regard to their mathematical creativity (along with dimensions) and achievement. Simple random sampling technique was used to select the sample (N=180, boys 99 and girls 81). Mathematical creativity was measured using the creative ability in mathematics test developed by Balka (1974). Pearson's Product Moment Correlation analysis indicated that mathematical creativity (along with its dimensions) is related to achievement in mathematics of eighth grade students. No significant difference was found between boys and girls with regard to their achievement and mathematical creativity (along with its dimensions). However, girls were found better than boys on one dimension of mathematical creativity i.e. flexibility.

MATHEMATICAL ANXIETY

Sherman and Wither (2003) conducted an experimental study on the students from the three schools of suburban Adelaide in South Australia. Data was collected by using the achievement test in mathematics and mathematics anxiety scale. Data was analysed and found significant negative correlation between mathematical achievement and mathematical anxiety. The authors concluded that mathematics anxiety caused a deterioration of mathematics achievement.

Mahmood and Khatoon (2011) examined the effects of school type, gender and mathematical anxiety on mathematics achievement on 863 males and 789 females from 15 secondary schools of Uttar Pradesh. The results showed that among of three independent variables, school type had the greatest influence on mathematics achievement; mathematics anxiety comes second in order while gender showed no significant influence.

Filiz and Dikkartin (2012) conducted a study to find out the relationship between achievement in mathematics and mathematics anxiety. The study was conducted on 5th – 8th graders students of Sindirgi District of Balikesir province. An exploratory factor analysis was performed by the researcher to examine the structural validity and factor structure of anxiety scale. In this study the 89 students from each class selected through random sampling method participated in scale development part of the study and 155 students participated in the application after scale being developed. 30 of 155 students receive education in 5th grade, 33 of them in the 6th grade, 54 of them in 7th grade and 38 of them in 8th grade. The data was analysed statistically and results were obtained which showed that achievement in mathematics and anxiety scores together indicated a significantly negative correlation r = -.660, p< .001.

STATEMENT OF THE PROBLEM
A STUDY OF CREATIVITY IN MATHEMATICS IN RELATION TO MATHEMATICAL ANXIETY OF ADOLESCENTS

OBJECTIVES OF THE STUDY

1.   To investigate the significance of difference in creativity in mathematics among rural and urban adolescents.

2   To find the relation between creativity in mathematics and mathematical anxiety of adolescents.

3.   To find the relation between creativity in mathematics and mathematical   anxiety of rural adolescents.

4.   To find the relation between creativity in mathematics and mathematical   anxiety

   of urban scheduled caste students.

HYPOTHESES

Directed towards the objectives of the study and on the basis of review of the related literature, following null hypotheses were formulated for the verification-:

H1.   There will be no significant difference between creativity in mathematics among rural and urban adolescents.

H2. There will be no significant relationship between creativity in mathematics and mathematical anxiety of adolescents.

H3. There will be no significant relationship between creativity in mathematics and mathematical anxiety of rural adolescents.

H4. There will be no significant relationship between creativity in mathematics and mathematical anxiety of urban adolescents.

Operational definition of the variables:

Mathematical Anxiety

According to Mahmood and Khatoon (2010) mathematical anxiety often leads to avoidance of math by those who experience it. Often students who are anxious, bored and fearful towards Mathematics or who do not comprehend the importance of Mathematics in personal and professional life are the one most likely to avoid the study of Mathematics. The scores of the Mathematical anxiety scale (2010) by Mahmood and Khatoon were taken as mathematical anxiety.

Mathematical Creativity

According to Sharma and Sansanwal (2012) Mathematical creativity is overcoming fixation as well as proposing and even testing unusual solutions of problems of Mathematics and the aspects of mathematical creativity namely fluency, flexibility and originality. The total scores on fluency, flexibility and originality that were measured by

the S^2MCT (Sharma and Sansanwal mathematical creativity test) were taken as mathematical creativity in the present study.

Fluency of thinking:

As the ability to call up ideas, where the quantity and not quality or idea is emphasized. The measure of fluency was the fluency score obtained by the subject on S^2MCT.

Flexibility of thinking:

It is the ability to produce a diversity of ideas or categories in a situation that is relatively unstructured. Its measure was the flexibility score on S^2MCT.

Originality:

It is the ability to produce remotely associated or uncommon responses. The measure was the originality scores obtained by the subject on the S^2MCT.

DESIGN OF THE STUDY

The study was designed to investigate creativity in mathematics in relation to mathematical anxiety of rural and urban adolescents. The nature of the investigation was descriptive survey method, because this method is considered useful to gather data from a relatively large number of cases at a time and collect detailed descriptions of existing phenomenon. The prior permission of the school authority was taken for collecting data. The investigator divided the procedure of data collection into two phases. In the first phase the investigator administered the mathematical creativity test to the intact section of secondary school students one by one, because the administration of the mathematical creativity test is very time consuming and difficult process. The students were told the objective of the data collection, then the response sheets of the mathematical creativity test were distributed and they were asked to fill up the basic information. Further instructions for giving responses were given. The students were free to ask from investigator if there is any communication problem. After completion, the response sheet was collected from the students. In the same way in the second phase the data on mathematical anxiety scale were collected.

SAMPLE

The study was conducted on a sample drawn from the 10th grade secondary school students of Punjab State. 800 students from the Government secondary schools affiliated to P.S.E.B. Mohali were selected by the technique of randomization. 400 students from the urban and 400 from the rural were selected for the study

TOOLS

Tools are devised to evaluate or measure behaviour in a standardized way for the purpose of selection, classification, prediction and guidance as well as for the evaluation of educational programme. Tools consist of a series of tasks which the subject is required

to perform. A standardized tool is one that has specific direction for administration and scoring, a fixed set of test items and has been administered to representative samples taken from the population for whom the tool is intended for the purpose of establishing norms. While selecting tool for collecting data in research, researcher must evaluate their validity, reliability and usability. In the present study, Investigator used the following tools.

1. Mathematical anxiety Scale (2010) by Mahmood and Khatoon to assess mathematical Anxiety of the students.
2. Mathematical Creativity test (2012) by Sharma and Sansanwal to assess mathematical creativity of students.

DELIMITATIONS OF THE STUDY

The present study was delimited to the following areas:

1. Creativity was considered as the mathematical creativity only.

2. The Study was restricted to scheduled caste students of P.S.E.B. of 10th class only.

3. The study was delimited to the Punjab State only.

Results and discussion

Table 1 Significance of difference in creativity in mathematics of rural and urban adolescents (N=400)

	Mean	Standard deviation	t-ratio
Rural adolescents	26.63	7.19	0.578 (N.S.)
Urban adolescents	26.95	8.64	

N.S. means non-significant

Table 1 reveals that the values of mean for rural and urban adolescents are 26.63 and 26.95 respectively. The value of t- ratio is 0.578 which is non significant at both the levels of significance. Thus there is no significance difference in the creativity in mathematics of rural and urban adolescents. This leads to acceptance of null hypothesis 1 which states that "There will be no significant difference between creativity in mathematics of rural and urban adolescents."
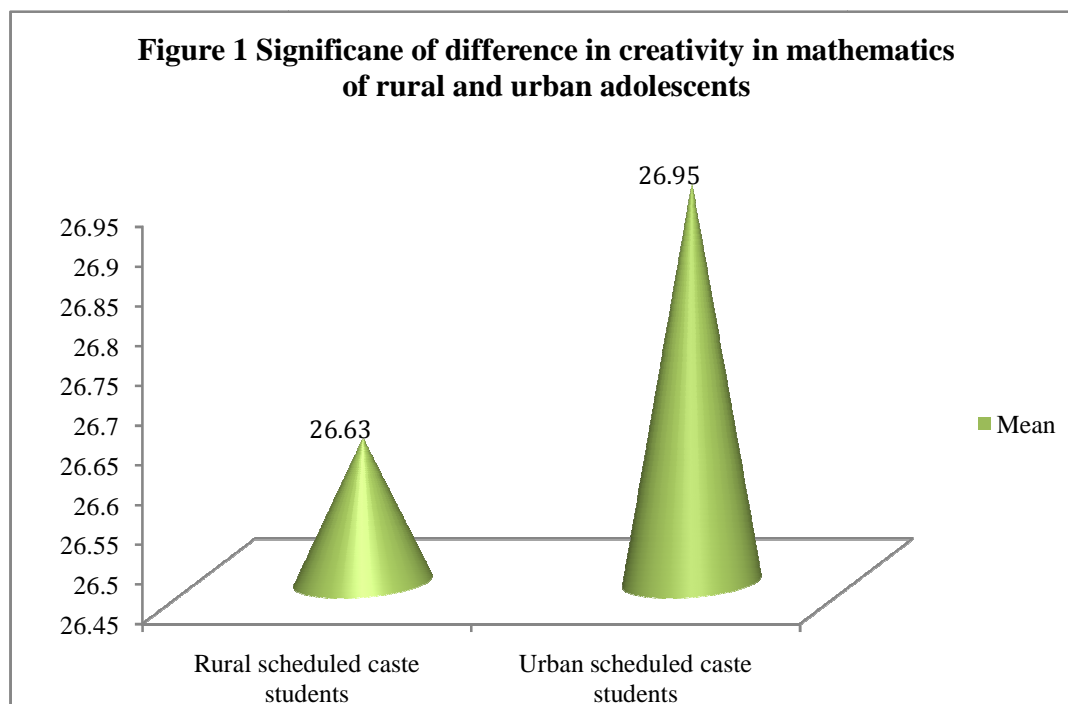
Figure 1 Significane of difference in creativity in mathematics of rural and urban adolescents

Table 2: Significance of relationship between and mathematical anxiety creativity in mathematics of adolescents.

Variables	N	r
Mathematical anxiety	800	0.112**
Fluency dimension of creativity in mathematics		
Mathematical anxiety	800	0.185**
Flexibility dimension of creativity in mathematics		
Mathematical Anxiety	800	0.114**
Originality dimension of creativity in mathematics		

**Significant at 0.01 level of significance

Table 2 reveals that for adolescents the value of correlation for a mathematical anxiety and fluency dimension of creativity in mathematics is 0.112. The value of correlation for mathematical anxiety and flexibility dimension of creativity in mathematics is 0.185. The value of correlation for mathematical anxiety and originality dimension of creativity in mathematics is 0.114. All these values are significant at 0.01 level of significance. Thus there exist significant positive relation between mathematical anxiety and mathematical creativity for scheduled caste students. This leads to the rejection of null hypothesis 1 which states that "There will be no significant relationship between creativity in mathematics and mathematical anxiety of adolescents."
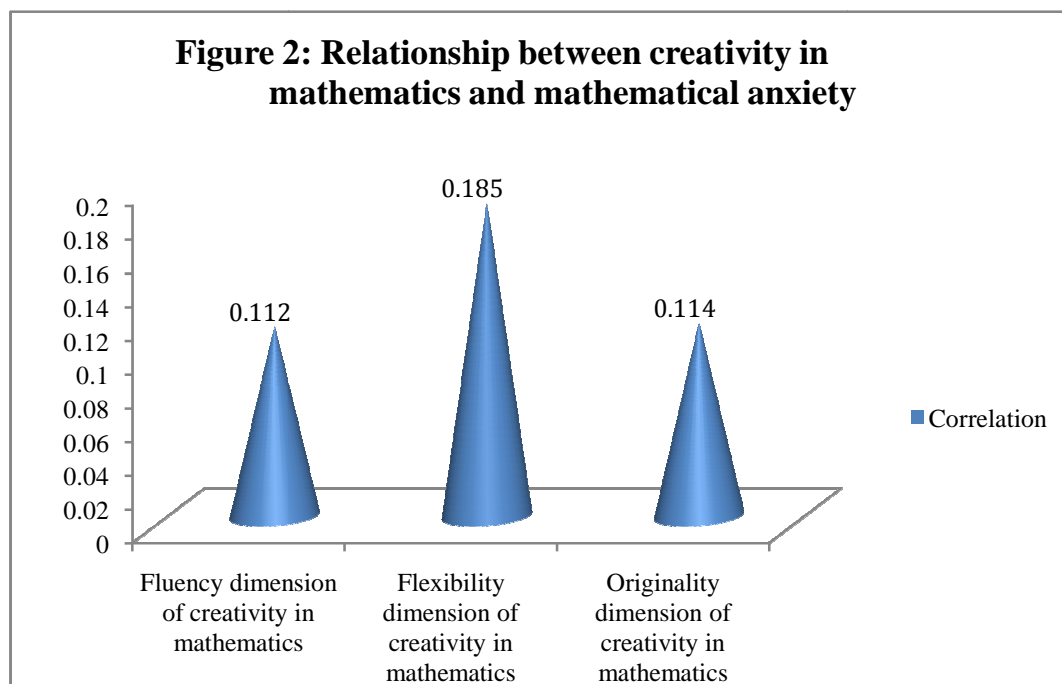
Figure 2: Relationship between creativity in mathematics and mathematical anxiety

Table 3: Significance of relationship between mathematical anxiety and creativity in mathematics of rural adolescents.

Variables	N	r
Mathematical anxiety	400	0.107*
Fluency dimension of creativity in mathematics		
Mathematical anxiety	400	0.107*
Flexibility dimension of creativity in mathematics		
Mathematical anxiety	400	0.120*
Originality dimension of creativity in mathematics		

Significant at 0.05 level of significance

Table 3 reveals that for rural adolescents the value of correlation for mathematical anxiety and fluency dimension of creativity in mathematics is 0.107. The value of correlation for mathematical anxiety and flexibility dimension of creativity in mathematics is 0.107. The value of correlation for mathematical anxiety and originality dimension of creativity in mathematics is 0.120. All these values are significant at 0.05 level of significance. Thus there exist significant positive relation between mathematical anxiety and mathematical creativity for rural adolescents. This leads to the rejection of null hypothesis 2 which states that "There will be no significant relationship between mathematical anxiety and mathematical creativity of rural adolescents."
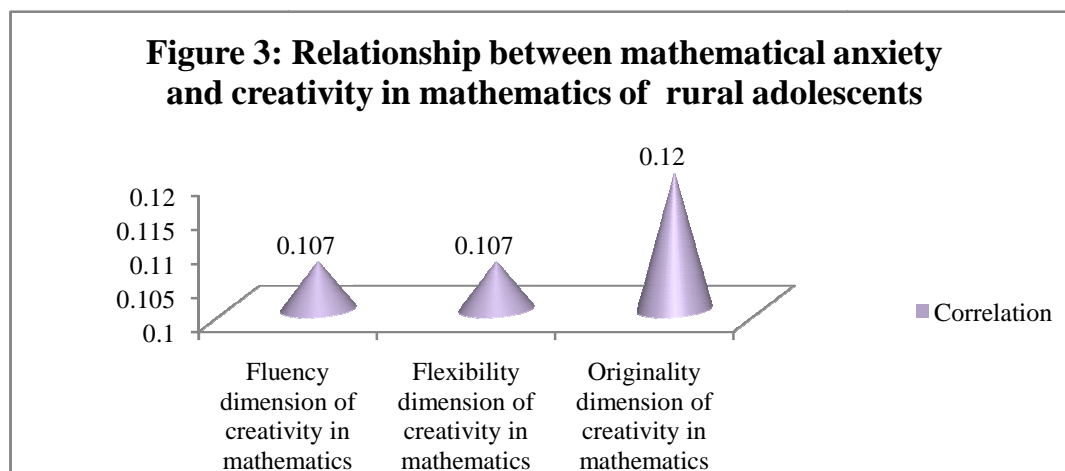
Figure 3: Relationship between mathematical anxiety and creativity in mathematics of rural adolescents

**Table 4: Significance of relationship between mathematical anxiety and creativity in mathematics of urban adolescents.**

Variables	N	R
Mathematical anxiety	400	0.115*
Fluency dimension of creativity in mathematics		
Mathematical anxiety	400	0.515**
Flexibility dimension of creativity in mathematics		
Mathematical anxiety	400	0.120*
Originality dimension of creativity in mathematics		

Significant at 0.05 level of significance
**Significant at 0.01 level of significance

Table 4 reveals that for urban adolescents the value of correlation for Mathematical anxiety and fluency dimension of creativity in mathematics is 0.115. The value is significant at 0.05 level of significance. The value of correlation for Mathematical anxiety and flexibility dimension of creativity in mathematics is 0.515. The value is significant at 0.01 level of significance The value of correlation for Mathematical anxiety and originality dimension of creativity in mathematics is 0.120 The value is significant at 0.05 level of significance. Thus there exist significant positive relation between Mathematical anxiety and creativity in mathematics for rural adolescents. This leads to the rejection of null hypothesis 3 which states that 'There will be no significant relationship between mathematical anxiety and creativity in mathematics of urban adolescents.

Figure 4: Relationship between mathematical anxiety and creativity in mathematics of urban adolescents.
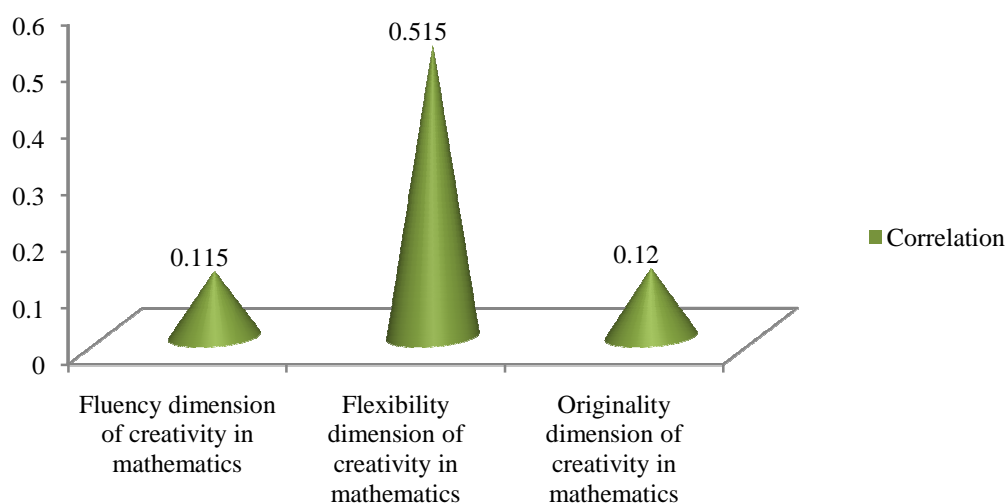
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