

## CORRELATES OF PUPILS' MATHEMATICAL CREATIVITY

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### ABSTRACT

*The aim of the present investigation was to study the relationship of mathematical creativity with mathematics anxiety, attitude towards mathematics, cognitive style, and meta-cognition separately. The survey method was used. The sample comprised 658 secondary school students selected from fifteen different schools of Jalandhar, Kapurthala and Shaheed Bhagat Singh Nagar Districts of Punjab State. Standardized tools were used to assess the variables, namely, mathematical creativity, mathematics anxiety, attitude towards mathematics, cognitive style, and metacognition. The data were analyzed with the help partial correlation technique. Mathematical creativity was found to be positively and significantly related with attitude towards mathematics, cognitive style, and meta-cognition.*

### INTRODUCTION

The identification and nurturing of mathematical talents and of creative thinkers became basic to the progress of any nation (Johny, 2008). A review of the literature about mathematical creativity reveals various definitions, and interpretations to this question. Sharma (2009) analyzed various definitions of mathematical creativity and operationally defined mathematical creativity as an ability to overcome fixation as well as conceptualizing, proposing, and even testing unusual solutions of problem(s) of mathematics.

Relationship between attitude towards mathematics and mathematical creativity was studied by Tuli (1981, 1985a, 1985b) and Singh (1988). Mathematical creativity was not significantly correlated with attitude towards mathematics (Tuli, 1981, 1985a and 1985b). Attitude towards mathematics was not significantly related to verbal mathematical creativity (Singh, 1988). Coefficients of correlation between non-verbal, and total mathematical creativity were found to be significantly related to attitude towards mathematics (Singh, 1988).

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Regarding the relationship of mathematics anxiety with mathematical creativity, Haylock (1987) found mathematical creativity was significantly inversely related to as well as mathematics anxiety. However, Fetterly (2010) neither confirmed nor denied the significant relationship between mathematical creativity and mathematics anxiety.

The relationship between mathematics achievement with various cognitive style dimensions and meta-cognition attracted the attention of several researchers worldwide. However, no study has been found in which relationship between mathematical creativity with cognitive style dimensions and meta-cognition has been explored.

While the research is inconclusive, mathematics anxiety, attitude towards mathematics, cognitive style, and meta-cognition may emerge as correlates of mathematical creativity. Moreover, mathematical creativity ensures the growth of the field of mathematics as a whole (Sriraman, 2004), so, it would be worth to study the relationship that may emerge between mathematical creativity and variables, like, mathematics anxiety, attitude towards mathematics, cognitive style, and meta-cognition. Keeping this in mind, it was thought to study mathematics anxiety, attitude towards mathematics, cognitive style, and meta-cognition in relation with mathematical creativity of the students.

### **OBJECTIVE**

The specific objective of the study was:

To study the relationship of mathematical creativity with mathematics anxiety, attitude towards mathematics, cognitive style, and metacognition separately.

### **HYPOTHESES**

In order to realize the objective of the study outlined above, the following statistical null hypotheses were formulated:

There is no significant correlation between mathematical creativity and mathematics anxiety of secondary school students by partialling out the influence of attitude towards mathematics, cognitive style, and meta-cognition.

There is no significant correlation between mathematical creativity and attitude towards mathematics of secondary school students by

partialling out the influence of mathematics anxiety, cognitive style, and meta-cognition.

There is no significant correlation between mathematical creativity and cognitive style of secondary school students by partialling out the influence of mathematics anxiety, attitude towards mathematics, and meta-cognition.

There is no significant correlation between mathematical creativity and meta-cognition of secondary school students by partialling out the influence of mathematics anxiety, attitude towards mathematics, and cognitive style.

### **SAMPLE**

In this study, 658 secondary school students were selected from fifteen different schools of Jalandhar, Kapurthala and Shaheed Bhagat Singh Nagar Districts of Punjab State. The participants varied by gender (male = 334 and female = 324) and grade (class VII = 280, Class IX = 172 and class X = 206).

### **INSTRUMENTS**

The following instruments were used for collection of data:

Sharma and Sansanwal Mathematical Creativity Test ( $S^2$ MCT). The mathematical creativity of students was assessed with the help of  $S^2$  MCT developed in 2012.

Mathematics Anxiety Scale (MAS). This MAS developed by Sharma and Sansanwal (2011) was used as a measure of mathematics anxiety.

Attitude towards Mathematics Scale (ATMS). The ATMS developed by Sharma (2009) was used as a measure of students' attitude towards mathematics.

Inventory of Metacognitive Self Regulation (IMSR). IMSR developed by Howard, McGee, Shia, & Hong (2000) was used a measure of students' meta-cognition score.

### **PROCEDURE**

The instruments were administered and scored as per the directions of the respective manuals.

**DATA ANALYSIS AND RESULTS**

The objective of the present investigation was to study the relationship of mathematical creativity with mathematics anxiety, attitude towards mathematics, cognitive style, and metacognition separately. The data in respect of this objective were analysed by using partial correlation technique. The partial correlations between predictor and criterion variables are given in the Table 1.

TABLE 1

Inter-correlations for mathematical creativity and the criterion variables

Variable	1	2	3	4
Mathematical creativity Predictor variable				
Mathematics a nxiety Attitude towards	-.05	.14**	.09*	.18**
mathematics Cognitive style				
Metacognition				

Ho1: Mathematical Creativity and Mathematics Anxiety

From Table 1, it can be seen that the partial correlation between mathematical creativity and mathematics anxiety while partialling out the influence of attitude towards mathematics, cognitive style, and meta-cognition was -.05, which is not significant at 0.05 level. In this context, the null hypothesis, namely, “There is no significant correlation between mathematical creativity and mathematics anxiety of secondary school students by partialling out the influence of attitude towards mathematics, cognitive style, and meta-cognition”, is not rejected. It may, therefore, be said that mathematical creativity was not found to be significantly related with mathematics anxiety when effect of attitude towards mathematics, cognitive style, and meta-cognition was held constant.

Mathematical Creativity and Attitude towards Mathematics :

From Table 1, it can be seen that the partial correlation between mathematical creativity and attitude towards mathematics while partialling out the influence of mathematics anxiety, cognitive style, and meta-cognition was -.14, which is significant at 0.01 level. In this context, the null hypothesis, namely, “There is no significant correlation between mathematical creativity and attitude towards mathematics of secondary school students by partialling out the influence of mathematics anxiety, cognitive style, and meta-cognition”, is rejected. It may, therefore, be said that mathematical creativity was found to be positively and

significantly related with attitude towards mathematics when effect of mathematics anxiety, cognitive style, and meta-cognition was held constant.

#### Mathematical Creativity and Cognitive Style :

From Table 1, it can be seen that the partial correlation between mathematical creativity and cognitive style while partialling out the influence of mathematics anxiety, attitude towards mathematics, and meta-cognition was  $-.09$ , which is significant at  $0.05$  level. In this context, the null hypothesis, namely, "There is no significant correlation between mathematical creativity and cognitive style of secondary school students by partialling out the influence of mathematics anxiety, attitude towards mathematics, and meta-cognition", is rejected. It may, therefore, be said that mathematical creativity was found to be positively and significantly related with cognitive style when effect of mathematics anxiety, attitude towards mathematics, and meta-cognition was held constant.

#### Mathematical Creativity and Meta-cognition :

From Table 1, it can be seen that the partial correlation between mathematical creativity and meta-cognition while partialling out the influence of mathematics anxiety, attitude towards mathematics, and cognitive style was  $.18$ , which is significant at  $0.01$  level. In this context, the null hypothesis, namely, "There is no significant correlation between mathematical creativity and meta-cognition of secondary school students by partialling out the influence of mathematics anxiety, attitude towards mathematics, and cognitive style", is rejected. It may, therefore, be said that mathematical creativity was found to be positively and significantly related with meta-cognition when effect of mathematics anxiety, attitude towards mathematics, and cognitive style was held constant.

### **DISCUSSION**

The first finding was that mathematical creativity was not found to be significantly related with mathematics anxiety when effect of attitude towards mathematics, cognitive style, and meta-cognition was held constant. However, on further probe it was found that the bivariate relation between mathematical creativity and mathematics anxiety was  $-.17$  ( $N= 658$ ). So, the finding, like, Fatterly (2010) neither confirms nor denies the significant relationship between mathematical creativity and mathematics anxiety.

The second finding was that mathematical creativity was found to be positively and significantly related with attitude towards mathematics when effect of mathematics anxiety, cognitive style, and meta-cognition was held constant.

The finding is in contrast with Tuli (1981, 1985a, 1985b). The reason of the present finding may be that by having positive attitude towards mathematics, the students may have been receptive to the mathematical creativity problems. Their positive attitude may have removed the mental barriers of mathematical creativity. However, the contrasting nature of the findings suggests that further studies are needed to be certain about the relationship between mathematical creativity and attitude towards mathematics.

The third finding was that mathematical creativity was found to be positively and significantly related with cognitive style when effect of mathematics anxiety, attitude towards mathematics, and meta-cognition was held constant. Cognitive Style describes the way an individual thinks, perceives and remembers information, or his preferred approach to using such information to solve problems. In the present study, GEFT was used that assesses the field independent-dependent dimensions of cognitive style. Field-independent (FI) subjects are those with a greater capacity to break perceptual information down into its component parts and to focus attention on those parts which are relevant, without being distracted by the context. In contrast, field-dependent subjects are those with a greater difficulty to disembed parts from their context (Tinajero & Paramo, 1998). The achievement in mathematics has been significantly related with Cognitive Style (Buriel, 1978; Vaidya and Chansky, 1980; Roberge and Flexer, 1983; Frank, 1986; Roszkowski and Snelbecker, 1987; Shrivastava, 1992; Tinajero, and Páramo, 1998; Peklaj, 2003; Saha, 2007; and Kenth, 2009). Moreover, the finding is in line with Miller (2007) who found that the more field-independent an individual, the higher the creativity score.

The last finding of the study was that mathematical creativity was found to be positively and significantly related with metacognition when effect of mathematics anxiety, attitude towards mathematics, and cognitive style was held constant. The finding is unique in the sense that no previous study was found in which relation between mathematical creativity and meta-cognition was studied.

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