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Research Papers

ACHIEVEMENT IN RELATION TO MATHEMATICAL CREATIVITY OF EIGHTH GRADE STUDENTS

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Abstract

The present study was conducted to examine the relationship of mathematical creativity with achievement and differences between boys and girls with regard to their mathematical creativity (along with its dimensions) and achievement. Simple random sampling was used to select the participants. Participants (N= 180, boys = 99 and girls = 81) completed creativity test. 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.

Keywords: Achievement, Mathematical Creativity

INTRODUCTION

The main goal of mathematics education in schools is the mathematisation of the child's thinking. Clarity of thought and pursuing assumptions to logical conclusions is central to the mathematical enterprise. There are many ways of thinking, and the kind of thinking one learns in mathematics is an ability to handle abstractions, and an approach to problem solving. The literature indicates that mathematical achievement is most often measured by speed and accuracy of a student's computation with little emphasis on problem solving and pattern finding and no opportunities for students to work on rich mathematical tasks that require divergent thinking. Teacher's tendency to accept only closed ended answers limits the use of creativity in the classroom and reduces mathematics to a set of skills to master and rules to memorize. It results in disappearance of natural curiosity and enthusiasm for mathematics. The creativity of mathematicians has been accepted as the insurance of the growth of the field of mathematics (Sriraman, 2004). Some theoreticians and teachers have believed that only creative mathematicians can be successful at contributing to the growth of the field of mathematics (King, 1992). Mathematical creativity is a rather complex phenomenon. According to Haylock (1987), there is no one conclusive definition to it. However, he suggests two approaches for identifying creative thinking in problem solving; the overcoming of fixation or the breaking of a mental set, and determining the criteria for a product to be indicative of creative thinking such as flexibility, originality and appropriateness. It is generally described in terms of three major components: fluency, flexibility, and originality. Fluency is the frequency or number of responses. Flexibility is the shift in categories or methods in the responses to a mathematical task. Originality is when a response is novel compared to other response.

Because of educators' apparent lack of interest, researchers have not emphasized creativity in

mathematics, so the relationship between mathematical creativity and mathematical achievement at the elementary and secondary level has remained unclear. The relationship between general academic achievement and domain-general creativity has been investigated by numerous studies after Getzels and Jackson's (1962) classic study of the role of creativity in school achievement. While some researchers have found high correlations between academic achievement and creativity (Torrance 1962; Yamamoto, 1964; Asha, 1980; Cicirelli, 1965; Counts, 1971; Murphy, 1973), some have not verified the correlation or have found low correlations between these two variables (Edwards & Tyler, 1965; Mayhon, 1966; Tanpraphat, 1976; Baird, 1985; Behroozi, 1997; Karimi, 2000; Nori, 2002). Despite the fact that all these studies have revealed informative results, the varied and conflicting conclusions of the studies make understanding the relationships between these two variables, especially in specific domains such as science, art, and mathematics, complicated and difficult. In terms of mathematics, Delis et. al (2007) suggested that traditional examination focusing on examining students' memorizing mathematics and reading skills has a negative relationship with creativity. Some researchers, on the other hands, believed that creativity can help to develop mathematics achievement. Mann (2006) claimed that by proving open-ended problems, students' mathematics ability and interest can be increased. In verbal form, fluency, flexibility, and originality scale of verbal form had significant correlations with mathematics achievement (Kaltsounis & Stephens, 1973; Mccabe, 1991). In figural form, fluency, flexibility and originality were found associated with mathematics achievement (Mccabe, 1991). Sak and Maker, 2006; Brunkalla, 2009; Ganihar and Wajiha, 2009; Kadir and Maker, 2011 also found significant relationship between mathematical creativity and achievement. However, Erdogan, Aydin, and Kabaca (2008) found no significant relationship between students' creativity and mathematics achievement.

Past researches have usually concentrated simply on whether there is a relationship between creativity and academic achievement without taking into consideration whether the relationship could be dissimilar for boys and girls on special aspects of creativity (Ai, 1999). Earlier investigations have revealed that an individual's background characteristics affect his/her cognitive and non-cognitive behaviors (Ai, 1999). Such studies indicated that gender is one of the most significant and influential characteristics in academic achievement (Ai, 1999; Fennema, 1998; Palaniappan, 2000; Naderi et al., 2008; Habibollah. et al., 2009) however, the literature on gender differences and the relationship between mathematical creativity and achievement is limited. Evans (1964), Jensen (1973) and Prouse (1967) reported significantly higher mathematical creativity scores for females than males. Jensen's (1973) study involved sixth graders at three schools in Texas. While the difference in mathematical creativity between the schools was not significant the gender differences varied across schools with a significant difference favouring females noted in one of the three schools and no difference at the other two. Prouse (1967) investigated creativity in seventh graders. He reported a significant mean difference in composite creativity scores favouring females. However, Ganihar (2009) found no gender differences in relation to mathematical creativity and research by Schmader, Johns, and Barquissau (2004) found that many college women still endorse the stereotypical views that men are superior to women in mathematics. Such a belief may have a negative effect on women's involvement in mathematics related fields.

The lack of conclusive results on the relationship of mathematical creativity and achievement in mathematics and gender differences was one of the motivations for conducting this study. This study presents an opportunity to add additional knowledge in the area of possible gender differences. In view of the forgoing discussion the investigator designed and conducted the present study with following objectives.

OBJECTIVES

1. To study the relationship between mathematical creativity (along with its dimensions) and achievement in mathematics of eighth grade students.
2. To study the difference between mathematical creativity (along with its dimensions) of boys and girls.
3. To study the difference between achievement of boys and girls in mathematics.

RESEARCH METHODOLOGY

Descriptive research methodology was used to find out relationship between mathematical creativity (along with its dimensions) and achievement in mathematics of eighth grade students. The

differences between boys and girls with regard to their mathematical creativity (along with its dimensions) and achievement were also studied.

SAMPLE

One eighty students out of two hundred eighteen students of eighth grade studying in D.A.V. Public School, Kurukshetra were selected randomly. Out of them ninety nine were boys and eighty one were girls.

STATISTICAL TECHNIQUE USED

Pearson's Product Moment Correlation was used to find the relationship between mathematical creativity (along with its dimensions) and achievement in mathematics of eighth grade students. Mean, S.D. was used to describe the sample and t-test was used to find the differences between boys and girls.

RESEARCH TOOL

One research tool was used to measure mathematical creativity developed by Balka, (1974). He devised six different criteria of creative mathematical ability into divergent and convergent activities. For the convergent criterion, he employed one for right response and zero for wrong response. For the divergent criterion, Balka employed fluency, flexibility, and originality as the scoring mechanism. For each scenario, fluency was scored for the number of responses. Flexibility was score for different categories of answers. As for originality, its score was weighted. Common answers were weighted with a score of zero. Answers that occur only in 4.99% of the sample population's response or less to a given situation are considered uncommon and it is weighted with a score of one. A response is weighted with a score of two, if the answer occurs in less than 2% of the sample population's response to a given situation. Balka reported the reliability of the CAMT as rxx = .72 (Cronbach's alpha) and a standard error of measurement of 7.24.

COLLECTION OF DATA

To conduct this study, investigator sought permission from the Principal of the school. SAMT (Sessional Assessment in Mathematics Test) scores were collected from the concerned class teachers. All the students were collected in a hall for administering the test. Rapport was established with the students, both written and oral instructions were given for all students and they were made ready to answer all the questions in CAMT. Data was collected and scored by the investigator according to the manual.

RESULTS AND DISCUSSION

The results of the study are based on the relationship between mathematical creativity (along with its dimensions) and achievement in mathematics. Results also include differences between boys and girls with regard to their mathematical creativity (along with its dimensions) and achievement. Mathematical creativity was measured by (CAMT) developed by Balka, (1974). Latest sessional assessment in mathematics was considered as achievement of students in mathematics. The results are divided into two sections. Section A deals with correlation between mathematical creativity (along with its dimensions) and achievement. Section B deals with differences between boys and girls with regard to their mathematical creativity (along with its dimensions) and achievement.

Section A

Table I

Correlation between Mathematical Creativity (along with its dimensions) and Achievement in Mathematics

Sr.No.	Variable	r	Significance level
1.	Achievement vs convergent thinking	.487	Sig. at 0.01
2.	Achievement vs fluency	.686	Sig. at 0.01
3.	Achievement vs flexibility	.727	Sig at 0.01
4.	Achievement vs originality	.552	Sig. at 0.01
5.	Achievement vs total creativity	.725	Sig. at 0.01

*Correlation is significant at 0 .01 levels (2-tailed)

Table I shows that correlation between mathematical creativity (along with its dimensions) and achievement in mathematics is significant. It means the students having higher level of mathematical creativity (along with its dimensions) are likely to have better scores in mathematics.

The result of the study is supported by Kaltsounis & Stephens, 1973; Mccabe, 1991; Mann, 2006; Sak and Maker, 2006; Ganihar et.al. 2009; Brunkalla, 2009; Kadir & Maker, 2011, found a significant relationship between mathematical creativity and achievement in mathematics. Brunkalla (2009) stated that students have higher academic achievement if they like mathematics and have positive feelings about it. Creative thinking activities are such alternative instructional methods to make mathematics more enjoyable and to create a positive attitude towards it. According to the findings, creative thinking activities in mathematics course affect the students' academic achievement positively. Positive relationship of general creativity and academic achievement is found by the researches (Torrance 1962; Yamamoto, 1964; Asha, 1980; Cicirelli, 1965; Counts, 1971; Murphy, 1973). They also support the significant relationship between the two. Present study found a positive relationship between mathematical creativity and achievement. The interpretation of the result is that mathematical creativity facilitates achievement of students because students enjoy creative thinking experiences, and they can learn mathematical concepts and processes while also applying their creative thinking in the use of mathematical principles. Without fear of rejection, students give multiple answers of one question, consequently knowledge, understanding, skill and application is enhanced. When teacher provides the opportunity to give open ended answer than the level of achievement is increased.

Section B

Table II

Differences between Boys and Girls with Regard to their Achievement and Mathematical Creativity (Along With Its Dimensions)

VARIABLE	BOYS/ GIRLS	N	Mean	S.D.	t-ratio	SED	Significance Level
ACHIEVEMENT	Boys	99	49.45	18.64	1.41	2.726	Insignificant at .05 level
	Girls	81	53.31	17.63			
CONVERGENT THINKING	Boys	99	0.84	0.68	0.48	0.106	Insignificant at .05 level
	Girls	81	0.89	0.74			
FLUENCY	Boys	99	13.64	8.66	1.94	1.389	Insignificant at .05 level
	Girls	81	16.33	9.97			
FLEXIBILITY	Boys	99	9.80	6.26		0.918	*significant at .05 level
	Girls	81	11.62	5.96	1.98*		
ORIGINALITY	Boys	99	1.47	2.22	0.66	0.349	Insignificant at .05 level
	Girls	81	1.70	2.45			
TOTAL CREATIVITY	Boys	99	25.75	16.63	1.87	2.570	Insignificant at .05 level
	Girls	81	30.54	17.77			

* Significant at .05 levels

Table II shows that differences between boys and girls. There is no significant difference on convergent thinking and originality but it shows positive direction towards fluency. However, significant difference was found on flexibility which is in favours of girls. It means girls are more mathematically creative in flexibility than boys. The table II also reveals that the difference between boys and girls with regard to achievement in mathematics, which is not significant also. In other words, gender does not affect the achievement of students in mathematics.

The result of the study indicate that there exists gender differences regarding specific dimension of mathematical creativity i.e. flexibility One interpretation that might explain this gender difference is that males and females do extremely well in different aspects of creativity. This dissimilarity may be possibly due to gender identity. Some studies (Ai, 1999; Palaniappan, 2000; Sak & Maker 2006; Bare 2008; Habibollah, Rohani, Tengku Aizan & Jamaluddin, 2009) show that males surpass females on some components of creativity, but females are generally better than males on others.

Conclusion

1. There is significant relationship between mathematical creativity (along with its dimensions) and achievement in mathematics of eighth grade students.
2. In general, gender does not affect the achievement in mathematics and mathematical creativity (along with its dimensions); however girls were found better than boys in one dimension of mathematical creativity i.e. flexibility.

Educational Implications

- Teachers should not adopt the tendency to accept only closed ended answer.
- Teacher should provide an environment of practice and problem solving that stimulates creativity
- Teacher should change the mode of assessment to examine student's mathematisation abilities rather than procedural knowledge.
- To attract the students towards mathematics at higher level teachers should make connection between mathematical creativity and achievement right from the beginning.
- School should provide a variety of mathematical resources to teachers to increase mathematical creativity of the students.
- Students should be encouraged to participate in quiz programmes, exhibitions and other competitive tests related to mathematics.
- Pupils should be provided with free and necessary environment at home and school for learning mathematics and developing their own creativity.
- Pupils should encourage solving difficult and challenging mathematical tasks orally as well as in writing.
- The parents should train the children in doing independent work. They must appreciate the successful activities of their children.

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