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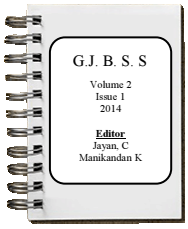

Mind Mapping: A tool for Mathematical Creativity

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Abstract

Creativity is an essential component of advanced mathematical thinking which is based on the previous experience of the learner together with a new direction to the past knowledge. Mind mapping is a powerful graphic technique which provides a universal key to unlocking the potential of the brain. The focus of the study is to find out the effect of mind mapping on Mathematical creativity. The study conducted on a sample of 100 students with 50 students each in the experimental and control groups established that Mind mapping is highly effective in developing mathematical creativity among higher secondary school students of Kerala, both for boys and girls.

Twenty first century, the era of knowledge explosion, need creative people who are scientifically and technologically well equipped. The routine ways of doing things always lead to disappointments and will not contribute to the advancement of society. It needs original and innovative ideas, and innovations are the products of creative thinking. Beyond that creativity has a significant role both at individual and social level. The individual part includes the creative approach to the problems that an individual meets where as the societal importance lies in various dimensions including scientific inventions, new artistic products and variety of social programmes which in turn determine the scientific, technological, economic, cultural and societal development of a nation. No path of life is free of creativity and it is very important to encourage students to develop the abilities to reason and think creatively.

Creativity is one of the most significant human activities. It is a dynamic concept exceptionally complex and undergoing transformations. It is a mental process through which one comes to accurate, unique and innovative results. Torrance (1974) suggested four components of Creativity, Fluency-the continuity of ideas, flow of associations and use of basic and universal knowledge; flexibility-changing ideas, approaching a problem in various ways and producing a variety of solutions; novelty-a unique way of thinking and unique products of mental or artistic activity; and elaboration –the ability to describe, illuminate and generalize ideas. Creativity can be general or specific. General creativity as explained by Leikin (2009) is associated with using problem solving patterns from one field, in solving problems in another field and specific creativity brings about creativity in a particular field by taking into account the logical deductive nature of the field.

Mathematical creativity is the activity of building, modernizing and completing the system of knowledge through noticing regularities, problem sensitivity and exposure of hypothesis as well as justifying proposition. It is characterized as independence and originality by Krutetskii (1976). Ervynck (1991) treated creativity as an essential component of advanced mathematical thinking which is based on the previous experience of the learner together with a new direction to the past knowledge. Thus mathematical creativity needs a context in which the individual is prepared by previous experiences for the significant step forward in a new direction. One can develop it through sense of proportion and symmetry, ability to use symbols, understanding of dimensions, understanding and usage of perspective, analysis,

synthesis and radiant thinking. The traditional methods of teaching Mathematics, though prepare students with sufficient computational skills, insufficiently prepare them for the development of their talents (Mann, 2006). Chamberlin and Moon (2005) have commented that the importance of mathematical creativity in school curriculum is minimized. Actually

Mathematics can be a perfect subject for the development of student's potential as promising and powerful creative thinkers. A qualitative study by Sriraman (2004) on four creative mathematicians revealed that the thinking process of mathematically creative people follow the Gestalt model of Preparation, incubation, illumination and verification. The study also defines mathematical creativity as the process that results in unusual and insightful solutions to a given problem, irrespective of the level of complexity. The Model-Eliciting activities are found to be effective both for developing and identifying mathematical creativity among middle grade students by Chamberline and Moon (2005).

The use of creative techniques can be a very effective way for students to develop a passion for learning mathematics. There are several strategies that might be used to enhance creativity of the pupils and deepen their understanding of mathematical concepts. These strategies might be classified in to the overlapping categories as appreciation, animation, association, alteration and abdication**.** These categories include brainstorming, sensory awareness attribute listing, modeling, make connections between a given situation, systematic change of parts or situations of problems etc.

Graphical presentations are found to be effective strategies for developing creativity among children. Kuveri (2013) in an experimental study found that concept mapping has a high level effect on scientific creativity. Mind maps may also influence the specific creativity of children. Preparation of mind map helps the students to understand how mathematical ideas interconnect and built on one another to produce a coherent whole.

Mind mapping is a powerful graphic technique which provides a universal key to unlocking the potential of the brain. They allow for greater creativity when recording ideas and information with visual representations. It trains the brain to see the whole picture and details to integrate logic and imagination. It allows for greater creativity when the ideas and information are recorded with visual representations. Images are more potent than words in triggering a wide range of associations and hence enhancing creative thinking and memory. It is easy to recall multi coloured, multi dimensional mind maps rather than traditional linear notes (Buzan & Buzan, 2006).

Main steps in preparation of mind maps are preparation, brain storming, revision and presentation. At the preparation stage mental attitude is prepared, and materials and environment are also made ready. In the brainstorming stage the child will discover the vast potential of his associative machinery. After that revise and present the mind map until it becomes a perfect one. Thangarajathi (2008) in a study found that mind mapping is effective in Mathematics teaching and it develops creativity among students. Present study is an attempt to find out how effective is the mind mapping technique to develop mathematical creativity.

Objectives

1. To find out whether experimental group has higher mean score of Mathematics Creativity than control group.
2. To find out whether there is gender difference in the mean score of Mathematical creativity in the experimental group.
3. To find out the effect size of Mind Mapping on mathematics Creativity.

Hypotheses

1. The experimental group has significantly higher mean score of Mathematics Creativity than the control group.

2. There is no significant gender difference in the mean score of mathematical creativity in the experimental group.
3. The effect size of Mind Mapping on Mathematics Creativity is high.

Method

Participants

The population of the study is the Higher Secondary School Students with mathematics as one of the subjects of study. The study was conducted on two randomly selected plus one classes with fifty students in each of two different institutions in Palakkad District of Kerala.

Instruments

1. The data was collected using creativity test Test of Mathematical Creativity, prepared and standardized by Sumangala (1998). The test contains ten items related to Mathematics to which respondent has to give their response which is scored based on the three dimensions of creativity, Fluency, flexibility and originality. Each item is to be responded within the time limit given in the test. While scoring, each component of creativity is scored separately for each item and the total score for each component was calculated. The total of the three components gives the score on mathematical creativity. The test-retest reliability coefficient of the test is 0.77. The criterion related validity of the test is 0.62.
2. The initial level mathematics achievement of Experimental and Control groups in the content 'Trigonometric ratios' was measured using an achievement test. The test contains 17 questions, 10 objectives, 6 short answers and one long answer. The test was prepared by following the steps of constructing an achievement test, that is preparing the design and blue print before writing the items. The discriminating power and difficulty index were calculated for each item and found that all the items are of satisfactory quality. The content validity of the test was ensured as it was developed based on the design and blue print. The test re-test reliability coefficient is obtained as 0.79.
3. Lesson plans for experimental group and the control groups were written separately on the same topics for same duration with the difference only in the consolidation stage of that for the experimental group. In the consolidation stage students of experimental group were asked to prepare mind maps on their understanding of the content taught in the class.

Procedure

Two divisions at Plus One level from two different schools of Palakkad, Kerala were selected randomly and one group was taken as the experimental group in which Mind mapping technique was introduced together with the conventional method of teaching and the other group was considered as the control group which was taught with the conventional method only. The two groups were taught the same topic 'trigonometry' for one month with 24 periods of one hour duration. Before introducing the treatment variable, an achievement test on Trigonometry was administered to both groups to know whether the two groups differ in their initial level of achievement. An introductory lesson on mind mapping was given for the experimental group to familiarize them about mind mapping. In order to avoid the influence of pre testing, the creativity test was administered only after the treatment.

Results and Discussion

In order to test whether the experimental and control groups are equal in their previous level of achievement in Mathematics, test of significance of difference between two

means for large independent groups were employed and the results obtained is presented as Table 1.

Table 1

Mean, SD and t value for Achievement in Mathematics of Experimental and Control Groups.

Group	Mean	SD	N	t-value
Experimental	3.9	1.87	50	1.10
Control	4.04	1.76	50	

The t-value obtained is less than 1.96 the value needed for significance at 0.05 level and hence the control group and experimental groups do not significantly differ in their mean scores in Achievement in Mathematics. Hence it can be considered that the two groups are equal in their previous level of Achievement in Mathematics.

The scores on Test of mathematical creativity was analysed with respect to their deviation from central value, mean score and significance of difference in the mean scores of the experimental and control groups as well as that of boys and girls in the experimental group.

Range of the scores on Test of Mathematical creativity in the experimental group is 9 and that of control group is 14. The maximum score obtained in the control group is 159 and that in the experimental group is 176. The minimum values are 145 and 168 respectively. These values mean that the dispersion of the scores in the experimental group is comparatively less than that of control group indicating that Mind mapping has a positive effect on the Mathematical creativity of the students. To test whether the experimental group has significantly higher mean score in mathematical creativity, one tailed test of significance of difference between means for large independent groups was employed. The details are summarized in Table 2.

Table 2

Means, SDs and t values of Mathematical Creativity for Experimental and Control groups and of the Boys and Girls in the Experimental group

Group	Mean	SD	N	t-value
Experimental	170.26	2.37	50	28.98**
Control	151.54	3.90	50	
Boys	169.96	2.52	25	0.67
Girls	170.42	2.47	25	

**p< .01

The mean scores obtained for experimental and control groups are 170.26 and 151.42 respectively. The standard deviation of the scores on Mathematical creativity for the experimental group is 2.37 and that of control group is 3.9. The calculated t value is 28.98. The hypothesis to be tested being a directional one, one tailed test of significance of difference between two independent samples were employed and the tabled value for significance of difference of the group means at 0.01 is 2.33. Hence the hypothesis that the experimental group has a higher mean score in Mathematical creativity than the control group is supported. The values of standard deviations of the scores indicate that the scores in the experimental group is less scattered than the control group indicating values in the experimental group more nearer to the mean score than that in the control group. The Cohen's d calculated to know the effect size of the Mind mapping technique on Mathematical creativity is 6 which indicate a

significant influence of the Mind mapping technique on Mathematical creativity. Hence it can be concluded that mind mapping is highly useful for enhancing mathematical creativity.

When the mean scores on Mathematical creativity obtained by boys and girls in the experimental group were compared it was found that the critical ratio obtained is far below the tabled value for significance at 0.05 level. Hence there is no significant difference in the mean scores on mathematical creativity of boys and girls in the experimental group. Hence mind mapping technique is equally useful for boys and girls for enhancing Mathematical creativity. Figure 1 shows the difference in the mean score in Mathematical creativity of control and experimental groups.

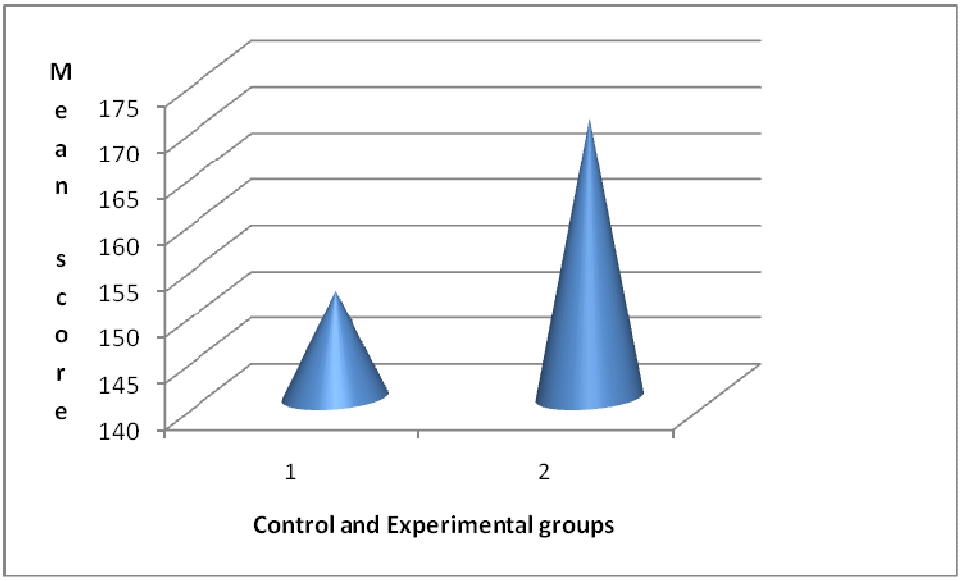

Figure 1: Mean scores in Mathematical creativity of Control group and Experimental group.

Figure 2 represents the mean scores in Mathematical creativity of boys and girls in the experimental group.

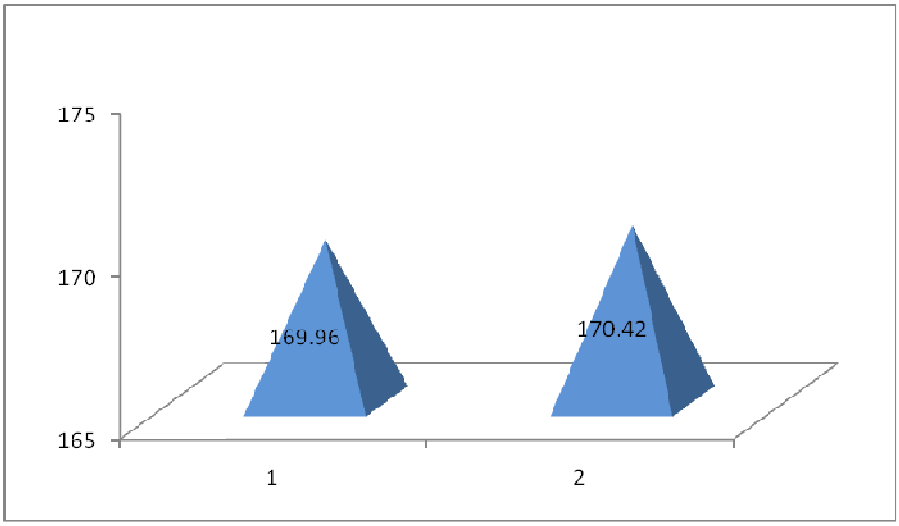

Figure 2: Mean Mathematical creativity scores of boys and girls in the experimental group.

The major finding of the present study that Mind mapping technique helps in developing mathematical creativity supports the findings of Thangarajathi (2008) and the theoretical explanation of Buzan and Buzan (2006).

Conclusion

The study reveals that Mind mapping is a powerful tool for enhancing Mathematical creativity, an important student outcome at all levels of mathematics education. In a class room, this aspect of development is usually neglected, especially by an average teacher and more importance is given to the mastery of the content, even cramming of the content. By this sole reason, majority of students get away from the subject and mathematics learning becomes a night mare for them. If the teacher encourages students to use a variety of techniques-both graphical and verbal, mathematics learning will become meaningful and enjoyable. Preparation of Mind maps helps the child to enjoy the learning process, memorize the learnt concepts logically, and use their power of expression effectively. It is also important that the misconcept of elders that using the graphical methods are childish and hence are recommended only for pupils of primary classes is to be removed. The study reveals that it is effective for higher secondary school students and a close observation of their activities during the experiment revealed that they are highly involved in the process of constructing new mind maps or modifying the existing one whenever they have learnt a new content or idea.

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