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Effectiveness of innovative technique on the working of brain and creativity and performance in mathematics of fifth class students

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Abstract

The present study was intended to investigate the effectiveness of abacus technique on the working of right and left sides of Brain, Creativity and Performance in mathematics among fifth class students. The study was conducted on 100 students of fifth class of two schools; Pre-Post test experiment control group design was employed. Abacus technique was treatment variable where as brain functioning of right and left hemisphere, creativity and performance were dependent variables. The findings of study reveal that abacus technique yielded higher gain scores than conventional class room teaching with respect to right and left brain functioning, elaboration (non verbal) and originality (non verbal) on creativity test and in performance of fifth class students in mathematics. Also the gain scores of performance time shows after treatment time taken was less and differ significantly for conventional class room teaching. The group target taught through Abacus technique took significantly less time for completing the same syllabus then the control group.

Keywords: Abacus technique, achievement in Mathematics, creativity, left and right side of brain functioning.

Introduction

In India, from time to time, various committees and commissions on education revived the education system and recommended reforms of its several facets, primary education has been the major concern of all education, since it is the foundation of entire superstructure of education.

According to Kothari Commission (1964-66), primary education can be divided into sub stages:

1. Lower Primary: It is of age group 6-10 years and is from I-V class.

2. Higher Primary: It is of age group VI-VIII class.

Piaget (1996) has postulated four stages through which the child's thinking process before reaching maturity. Present study deals with concrete operation stage. During this period child starts thinking in logical terms using mental operations.

The present study investigated the effect of abacus technique on the working of right and left sides of Brain, Creativity and Performance in mathematics of fifth class students.

Creativity

Guilford (1950) said that, "Creativity refers to ability that ismore characteristics of creative people.

Weinberg (1993) argued by contest, that creativity only involves ordinary cognitive processes yielding extruding results.

Balzac (2006) writes that creative innovation design requites "Captivation and communication between regions of the brain that ordinarily are not strongly concerted."

Creativity is basically a process of seeing and creating relationships with both conscious and subconscious process operating. It is a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies and so on, identifying the difficulties, searching for solutions, making guesses or formulating hypothesis about deficiencies, testing and re-testing these hypothesis and possibly modifying and re-testing them, finally communicating the results.

Creative products essentially include an element of newness which implies novelty, freshness and inventiveness. It is a quality of originality involving fusion of perception in new ways, finding new connections and relationships, production of new insights, molding of expense into new organizations of new constellations of meaning and innovations.

Traits of Creativity

Following are some important traits of creativity-

- Fluency of thinking -Able to think well and effortlessly
  - ✓ Word fluency -Can easily state words containing a given letter or combination of letters
  - ✓ Associational fluency -Can easily state synonyms for a given word
  - ✓ Expressional fluency- Can easily write well-formed sentences with a specified content.
  - ✓ Ideational fluency- Can easily produce ideas to fulfill certain requirements, for example to name objects that hare hard, white and edible, or to write an appropriate title for a given story.

- Sensitivity to problems-Can state difficulties or deficiencies in common products or in social institutions, make judgment that desired goals in a described situation have not been achieved
- Flexibility of thinking -Can easily abandon old ways of thinking and adopt new ones.
- Spontaneous flexibility- Can produce a great variety of ideas. For example in suggesting uses for a brick, subject can jump among categories, from building material to weight to missile to source of red powder.
- Adaptive flexibility -Can generalize requirements of a problem to find a solution. For example, in a problem of forming squares using a minimum number of lines, can abandon the usual idea that all squares have to be the same size.
- Elaboration -can fill in details given a general scheme.Given a general task, fill in the detailed steps. Given two simple lines, draw a more complex object
- Originality -Comes up with ideas that are statistically unusual
    - ✓ Remote associations Forms associations between elements that are remote from each other in time, or remote from each other logically
    - ✓ Responses are judged to be clever
- Redefinition -Gives up old interpretations of familiar objects and uses them in new ways .
- Interest in convergent thinking-Thinking towards one right answer, as in solving a mathematical problem stated in a textbook
- Interest in divergent thinking-Open-ended thinking, where there is not a single right answer

Right/ Left Brain

Mines *et.al.,* (1976) studied retention of visual pattern such as geometric design and graphs are believed to be in the domain of right hemisphere, high creativity as assonated with right hemisphere.

Dumas and Olsan (1977) included that mathematical functions, particularly, calculations and algebra are operated by the left hemisphere.

Balzac (2006) writes that creative innovation design requites"Captivation and communication between regions of the brain that ordinarily are not strongly concerted."

Hemispherity is the individual's brain capacity in acquiring and processing modes of information in its own styles of learning and thinking.

Both hemispheres right and left perform different function through different modes.

a person who is "left-brained" is often said to be more logical, analytical and objective, while a person who is "right-brained" is said to be more intuitive, thoughtful and subjective.

The Left Brain

The left-side of the brain is considered to be adept at tasks that involve logic, language and analytical thinking. The left-brain is often described as being better at:

- Language
- Logic
- Critical thinking
- Numbers
- Reasoning

The Right Brain

According to the left-brain, right-brain dominance theory, the right side of the brain is best at expressive and creative tasks. Some of the abilities that are popularly associated with the right side of the brain include:

- Recognizing faces
- Expressing emotions
- Music
- Reading emotions
- Color
- Images
- Intuition
- Creativity

To enhance creativity, and improve brain function and performance in mathematics among fifth class students abacus technique is used nowadays. The abacus is a tool having series vertical rods on which a number of wooden heads are allowed to slide freely.

Abacus

An Abacus is a manual aid to calculating that consists of beads or disks that can be moved up and down on a series of sticks or strings within a usually wooden frame. The Abacus itself doesn't calculate; it's simply a device for helping a human being to calculate by remembering what has been counted. The standard abacus can be used to perform, addition, subtraction, division and multiplication. It is a tool

that was founded 2000 years ago and universally used for solving arithmetic functions. One particular use of ABACUS is teaching children simple mathematics and especially on excellent substitute for rote memorization of multiplication tables.

The modern Chinese abacus, which is still widely used in China and other countries, dates from about 1200 A.D. It is possible that it derives from the earlier counting board s used around the Mediterranean as early as 300 B. C. An Aztec version of an ABACUS, circa 900-1000 A.D., is made from maize (corn) threaded through strings mounted in a wooden frame.

Relationship of Abacus with Brain functioning

Research on brain science reveals that there are two hemispheres of brain viz. left hemisphere and right hemisphere. Left hemisphere provides analytical information processing and is good at dealing with information concerning languages and sound and the right hemisphere provides integral information processing and is good at dealing with information concerning shapes and space.

In order to explore and develop the potentialities of human brain fully, many psychologist and brain scientist have been studying ways to develop the function of the right brain.

Taiwan, Miller and Stigler (1991) found that a higher level of abacus calculation skills resulted in formation of a mental abacus, and that abacus training changed children's reaction times in mental calculations.

A research study by Shizuko Amalwa (2001) shows that abacus study not only improves the ability to calculate both on the abacus and mentally, but also provides a ripple effect on other discipline.

Lu (2002) has conducted two experiments to test the impact on the memory span of mental ABACUS training. The results exhibited that the trained group had better performance than the non-trained group. The trained group performed mental calculation tasks with a shorter response time and higher percentage of accuracy. The two groups did not differ in the tests of backward digit span andcomplex spatial span tasks. The results also suggested that mental abacus training improvedsubjects' ability to store visual-spatial information.

UC Mass Mental Arithmetic Pvt. Ltd. (2005) uses this ancient tool, "Abacus" for the brain development and claims that with the help of abacus learning ability, photographic memory, skills concentration and performance of children can be improved.

Mental arithmetic was used to help students and to train the brain in enhancing the quality of all the perception, topping with better thinking laterally, linearly and in all directions.

Relation of Abacus Technique with Creativity and Performance

According to mental science, creativity is composed of creative thinking and creativeimagination. Creative thinking is the organic combination of emanative thinking and collective thinking. Creative imagination plays an important role in creative activities. To some extent, creative imagination is a

process of image thinking. Einstein considered re-organization of imagination as an essential feature of creative thinking. A child's early -stage creativity is mainly shown as creative imagination. The process of creation can be divided into four phases. The first phase is preparation phase. The second is brew phase. The third is maturity phase and the last is testing phase. In the first arid fourth phases, the left - brain exerts linguistic and logical functions so it plays a leading role. The second and third phases are a period for new ideas and new concepts, and the most important period in creation process, because there is no fixed mode for logical thinking available

for new thoughts. Thereupon, this period fully exerts right- brain functions of imagination instinct and inspiration, and other non -logic mental functions. It should be made clear that the left -brain and the right -brain are in close connection and coordination in each phase of creation process. So, the right brain plays a decisive role in creativity and creation both in mental science and brain science. Therefore, developing children' s creativity must start from developing children's right brains.

Toshio Hayashi (2000) in his lecture on ' What ABACUS Education ought to be for the Development of Right Brain also the same views on abacus learning. The Ripple Effects and the future Prospects of Abacus Learning, a research study by Shizuko Amalwa (2001) revealed that abacus study not only improves the ability to calculate both on the abacus and mentally, but also provides a beneficial ripple effect on other disciplines. These characteristics show positive ripple effects on the solution of various problems. Students can think different ways of doing things hence, enhancing their creativity.

To foster children's creativity, right -brain activities should be stressed to well develop the right brain while developing the left-brain. According to the Chinese Zhusuan Association, people are encouraged to drive beads with two hands when using an abacus; that is to say, one should drive beads with his two hands. Continual actions of this kind motivate fingers of the left hand and develop one's right -brain functions.

UC Mass, the whole brain development programme (2005) also aims at improving creativity and performance of young children with the help of abacus technique. The concept aimed at right brain development which leads to better creativity in students.

In the present study, two traits of creativitymentioned earlier in this research i.e. elaboration and originality are studied

Objectives

The study was designed to attain the following objectives:

(1) To study the effectiveness of Abacus technique on the functioning of brain of fifth class students.

(2) To study the effectiveness of Abacus technique on the creativity of fifth class students.

(3) To study the effectiveness of Abacus technique on the performance of fifth class students.

(4) To compare the performance time and performance in mathematics of students who are taught through Abacus with the students taught by routine methods.

Hypotheses

The study was designed to test the following hypotheses

H1. The results will show no significance difference on the right brain functioning of students taught through abacus and students taught through routine classroom method

H2. The results will show no significance difference on the left brain functioning of students taught through abacus and students taught through conventional classroom teaching.

H3. There will be no significance difference among students taught through abacus and students taught through routine classroom method on the scores of elaboration (non verbal)

H4. There will be no significance difference among students taught through abacus and students taught through routine classroom method on the scores of originality (non verbal).

H5. There will be no significance difference on the performance of students taught through abacus technique and students taught through conventional classroom teaching.

H6. There will be no significance difference in the performance time of students taught through abacus technique and students taught through routine classroom method

Methodology

Sample

In order to conduct the study, a sample of 100 students of fifth class students of school from Garhshankar and UC Mass Centre of Ropar were selected.

Tools

The following tools are used to collect data:

Tool 1 – Style of learning and thinking – SOLAT by M/s. Psy.com services

Tool 2 – Creativity Test by Baquer Mehndi.

Tool 3 – Performance Test (Prepared by the Investigator)

Design of the Study

In the present study pre-test post-test experimental control group design was employed. Abacus technique was a treatment variables whereas brain functioning of right and left hemisphere, creativity and the performance were dependent variables.

(a) The schematic representation of the design on achievement gain scores is presented in the Figure1, 2 and3 below :

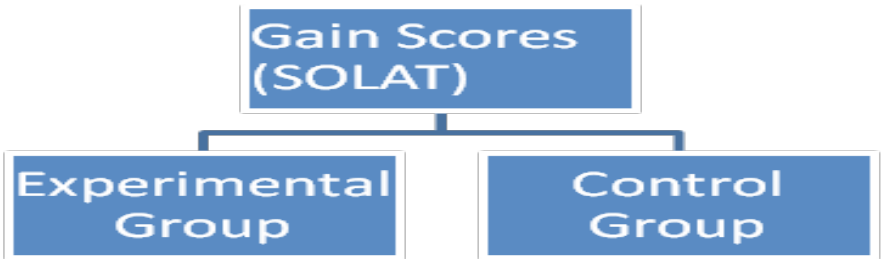

Fig. 1. Schematic Representation of the gain scores (solat) of experimental and control group.

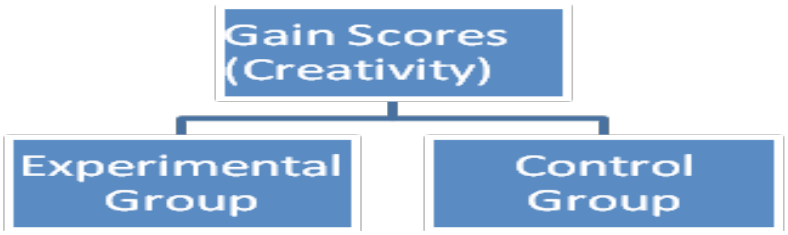

Fig. 2 Schematic Representation of the gain scores (Creativity) of experimental and control group.

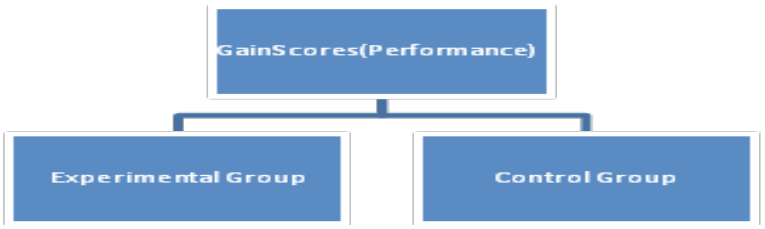

Fig. 3. Schematic Representation of the gain scores (Performance) of experimental and control group.

Procedures

In the experimental group of 50 students of fifth class of UC Mass SOLAT, Creativity test and Performance test before the treatment were administered. All the tests were scored separately. Same tests were administered to control group consisting of 50 students of fifth class. Pre achievement scores of both the group were noted. Then the same tests were administered to both the groups after the treatment was given to experimental group and pst test score were noted. Final sample retained of 72 students.

Statistical Technique

The following statistical technique were employed to analyze data :

(1) Mean and Standard Deviation.

(2) One way analysis of variance(ANOVA) on gain scores.

Analysis and Interpretations

The data has been analysed as following

(1) One way analysis of variance on the gain cores of right. brain functioning and left brain functioning

In order to analyse the data, the gain score were subjected to ANOVA (one way) .The results have been presented in the Table 1.

Table 1. Summary of one way anova for right brain functioning on gain scores of control group and exerimental group on solat

Source of variation	SS	df	MSS	F-ratio
Between sample	125.347	1	125.34	
Within sample		70	14.071	8.9108**
TOTAL	1110.319	71		

**Significance at the 0.01 level of confidence.

*Significance at the 0.05 level of confidence

It may be observed from the Table 1 that F-ratio for the difference in right brain functioning of control group and experimental group was found to be significant at 0.01 level of significance. This indicates that abacus technique helps in improving right brain tuning as compared to the conventional teaching, thus the results did not support hypothesis(1) H1 viz;" The results will show no significance difference on the right brain functioning of students taught through abacus and students taught through routine classroom method"

The means of control group and experimental group for gain scores have been presented in Table 2

Table 2. Means of Control and Experimental Groups for Gain Scores of Solat for Right Brain Functioning

Experimental group	M_E= 5.5
Control group	M_C= 2.8

The mean table reveals that mean of experimental group is higher than control group which mean abacus technique is significantly responsible for enhancing right brain functioning.

The results are in tune with the findings of Aloha India (1993), Dr. Toshio Hayashi (2000), a research study of Prof. Jhizabo Amalwa (2001) and conclusion of UC Mas Mental Arithmetic Pvt. Ltd. (2005).

Table 3. Summary of One Way Anova for Left Brain Functioning on Bain Scores of Control Group and Experimental Group on Solat

Source of variation	SS	df	MSS	F-ratio
Between sample	58.6806	1	58.6806	
Within sample	782.6309	70	11.1805	5.22484*
TOTAL	841.3195	71		

*Significance at the 0.01 level of confidence

** Significance at the 0.05 level of confidence

It may be observed from the Table 3 that F-ratio for the gain scores of left brain functioning of control group and experimental group was found to be significant at .01 level of confidence. This indicates that abacus technique helps in improving left brain functioning as compare to the conventional class room teaching. Thus, the result does not support hypothesis (2) H2 viz, The results will show no significance difference on the left brain functioning of students taught through abacus and students taught through conventional classroom teaching."

The means of control group and experimental group for gain scores have been presented in Table 4.

Table 4. Means of Control and Experimental Group for Gain Scores of Solat for Left Brain Functioning

Experimental group	M_E= 2.55
Control group	M_C= 0.75

The mean table reveals that mean of experimental group is higher than the control group which means abacus technique is significantly responsible for improving the left brain functioning as compared to classroom teaching.

The results are in tune with the findings of Aloha India (1993), Dr. Toshio Hayashi (2000),), a research study of Prof. Jhizabo Amalwa (2001) and conclusion of UC Mas Mental Arithmetic Pvt. Ltd. (2005).

(2) Analysis of variance for gain scores of elaboration (non- verbal) and originality (non-verbal).

In order to analyse the data, gain scores for elaboration (non-verbal) were subjected to Anova (one way). The results have been presented in the Table 5

Table 5. Summary of one way anova for gain score on elaboration (non-verbal) of control group and experimental group on creativity test (non verbal)

Source of variation	SS	df	MSS	F-ratio
Between sample	23.3471	1	23.3471	
Within sample	227.5278	70	3.2503	7.1830**
TOTAL	250.875	71		

**Significance at the 0.01 level of confidence.

* Significance at the 0.05 level of confidence.

It may be observed from the Table 5 that F-ratio for the gain scores of elaboration (non-verbal) of control and experimental group was found to be significant at 0.01 level of confidence.

This indicates that abacus technique helps in enhancing non- verbal creativity, as compared to conventional teaching. Thus the results did not support the hypothesis (3) viz., There will be no significance difference among students taught through abacus and students taught through routine classroom method on the scores of elaboration (non verbal)

The means of control group and experimental group for gain scores for elaboration (non-verbal) have been presented in Table 6.

Table 6. Means of Control and Experimental Group for Gain Scores of Elaboration (Non-Verbal)

Experimental group	M_E= 2.777
Control group	M_C= 1.638

The mean table shows that mean of experimental group is higher than the control group than which indicates that abacus technique is significantly responsible for enhancing creativity. The results are in tune with the findings of Aloha India (1993), Dr. Toshio Hayashi (2000)), a research study of Prof. Jhizabo Amalwa (2001) and conclusion of UC Mas Mental Arithmetic Pvt. Ltd. (2005).

Table 7. Summary of One Way Anova for Gain Score on Originality (Non-Verbal) of Control Group and Experimental Group on Creativity Test (Non Verbal)

Source of variation	SS	df	MSS	F-ratio
Between sample	16.0611	1	16.0611	
Within sample	228.939	70	3.2705	4.910*
Total	245.95	71		

**Significance at the 0.01 level of confidence.
*Significance at the 0.05 level of confidence.

It may be observed from the Table 7 that F-ratio for the gain scores of originality (non-verbal) on creativity test (non-verbal) was found to be significant at 0.05 level of significant This refuels that abacus technique helps in enhancing non- verbal creativity, as compared to conventional teaching. Thus the results did not support the hypothesis (4) viz.,There will be no significance difference among students taught through abacus and students taught through routine classroom method on the scores of originality (non verbal).

The means of control group and experimental group for gain scores for originality (non-verbal) have been presented in Table 8

Table 8. Means of Control and Experimental Group for Gain Scores of Originality (Non-Verbal)

Experimental group	M_E= 2.944
Control group	M_C= 2

The mean table-8 shows that mean of experimental group is higher than the control group which indicates that abacus technique is significantly responsible for enhancing creativity. The results are in tune with the findings Dr. Toshio Hayashi (2000),), a research study of Prof. Jhizabo Amalwa (2001) and conclusion of UC Mas Mental Arithmetic Pvt. Ltd. (2005).

(3) Analysis of Variance for Gain Scores of Performance Test.

For analyzing the data, the gain scores of performance test were subjected to ANOVA (one way)

Table 9. Summary of One Way Anova for Performance in Mathematics on Gain Scores of Control Group and Experimental Group

Source of variation	SS	d.f	MSS	F-ratio
Between sample	165.0139	1	165.0139	
Within sample	190.9723	70	2.7281	60.485**
TOTAL	353.9862	71		

**Significance at the 0.01 level of confidence.

*Significance at the 0.05 level of confidence.

It may be observed from the Table 9 that F-ratio for the gain scores of performance test is found to be significant at the 0.01 level of significance. This indicates that abacus technique results in better performance in mathematics as compared to through routine classroom teaching. Thus the result did not support the hypothesis (5) H5 viz, "There will be no significance difference on the performance of students taught through abacus technique and students taught through conventional teaching"

Table 10. Means of Control and Experimental Group for Gain Scores of Performance Test

Experimental group	M_E= 6.777
Control group	M_C= 3.75

The mean table shows that mean of experimental group is higher the control group which reveals that abacus technique is significantly responsible for improving performance in mathematics. The findings are in tune with finding of Kojima Takashi and claim of UC Mass Arithmetic Pvt. Ltd. (2005)

(4) Significance of difference of mean of control group and experimental group for performance time.

t-ratio was calculated and presented in the Table-11below:

Table 11. t-Ratio for difference in means of control and experimental group for performance time

MC = 12.719	ME	T-RATIO
σ_C = 5.788	σ_C	3.9393**
n_c = 36	n_E36	

**Significance at the 0.01 level of confidence.
*Significance at the 0.05 level of confidence.

The t-ratio was calculated for difference of means in post test scores of performance time of control group experimental group and from table 12, it was found that t-ratio is significant at 0.01 level of confidence which indicates that the time take by experimental group is significantly different from control group. It means abacus technique enhances speed of students in doing arithmetic calculations as compared to conventional teaching. Further the means of control group and experimental group reveals that the time taken by the experimental group was lesser than control group. Thus, the result did not support the Hypothesis H6 viz., 'There will be no significance difference in the performance time of students taught through abacus technique and students taught through routine classroom teaching." Thefindings are in tune with the finding of kojima Takashi and conclusion of UC Mas Mental Arithmetic Pvt. Ltd. (2005).

Results and Discussion

In the present study, the prominent finding is thatabacus technique yielded higher gain scores than conventional class room teaching in the right and left brain functioning which is in tune with studies of the findings of Aloha India (1993), Dr. Toshio Hayashi (2000), a research study of Prof. Jhizabo Amalwa (2001) and conclusion of UC Mas Mental Arithmetic Pvt. Ltd. (2005).

It is further found that that ABACUS technique yielded higher gain scores than conventional class room teaching, in elaboration(non verbal) and in originality (non verbal) on creativity test (non verbal) are in tune with studies of the findings of Aloha India (1993), Dr. Toshio Hayashi (2000), a research study of Prof. Jhizabo Amalwa (2001) and conclusion of UC Mas Mental Arithmetic Pvt. Ltd. (2005) and also abacus technique yielded higher gain scores than conventional class room teaching in performance of fifth class students in mathematics. Also the gain scores of performance time shows after treatment time taken was less and differ significantly fro conventional class room teaching. Students taught through abacus performed better than those taught through regular classroom teaching which is further in tune with the studies of Kojima Takashi(1987) and claims of UC Mass Mental Arithmetic Pvt. Ltd..

Implications

The finding of study suggests:

(1) Abacus technique can be used to improve brain functioning of children at an early age.

(2) Abacus technique should be used to foster creativity among young children.

(3) Abacus technique can be used to solve mathematical problem in Arithmetics.

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