Effectiveness of an Instructional Strategy Based on Abacus Techniques on Achievement and Numerical Ability in Mathematics at Upper Primary Level Students of Kerala, India

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ABSTRACT
The present study investigates the effectiveness of an instructional strategy based on Abacus techniques on achievement and numerical ability in Mathematics at upper primary level. The study is carried out on comparing Abacus techniques with the Present Method. Instructional strategies like knowledge, understanding and application are also analysed. Through this technique, the investigator analysed computation efficiency and numerical ability. The result of the study reveals that Abacus technique is more effective than Present Method on achievement and numerical ability in Mathematics of students at Upper Primary level. It is more effective in retaining the acquired knowledge for a long time than Present Method.

Keywords: Instructional strategy, Abacus techniques, Achievement, Numerical ability

I. INTRODUCTION
Mathematics is the only subject that encourages and develops logical thinking. It enables the students to discriminate between essential and non-essentials. It helps them shift fact, to draw conclusions and without ambiguity and that is a subject by which they may learn what is meant by rigid reasoning. Therefore, the inclusion of mathematics as a compulsory subject is very essential for training rational, trustworthy and useful citizens in a democratic society. The National Policy on Education (NPE) (1986) stated “Mathematics should be visualize as the vehicle to train a child to think, reason analyze, and to articulate logically”.

Abacus is a Latin word originated from the Greek words, abax or abakon which means table or tablet [4]. Abacus is a simple tool which was used in ancient times for calculating numbers through basic arithmetic system. For many centuries different races, cultures and countries have played an important role in the development of the tool. Abacus is a popular tool used for doing Mathematical Calculations with fast speed and accuracy. It's the most simple and practical way to learn arithmetic and developing one's Brainpower. Abacus uses Math as the base subject. It's the earliest calculating device of the world. Abacus has a frame
with colourful beads mounted on rods on it that are used for counting and doing the mathematical operations. Each bead has got a value. Moving the beads up and down does the calculations. Abacus has proven to be an ultimate Brain Development Program for children [2]. It is the foundation for a strong Mathematical Aptitude and improves concentration in all other areas. Numerical ability refers to the way a person perceives, processes and calculate numbers and numerical symbols.

Abacus Techniques helps the students to acquire knowledge, ideas, skills, values, computation efficiency and ways of thinking and means of expressing themselves [3]. In fact the most important long term outcomes of instruction may be the students increased capabilities to learn more easily and effectively in the future. Even though the present method of teaching is an activity oriented one, it does not provide ample opportunities to develop thinking and problem solving were as Abacus techniques develops and arouses interest in Mathematics. So the investigator selected Abacus Techniques as the experimental variable.

II. OBJECTIVES OF THE STUDY
To compare the effectiveness of strategy based on Abacus techniques with the present method of teaching on achievement in Mathematics of students at Upper Primary level.
To compare the effectiveness of strategy based on Abacus techniques with the present method of teaching on achievement in Mathematics under the categories of objectives, Knowledge Understanding Application
To compare the effectiveness of strategy based on Abacus techniques with the present method in improving Numerical Ability in Mathematics of students at Upper Primary level.
To compare the computation efficiency of students taught through instructional strategy based on Abacus techniques with the present method of teaching at Upper Primary School level.
To compare the time taken by the students taught through instructional strategy based on Abacus Techniques and the present method of teaching in completing successfully the following tests Achievement Test Numerical Ability Test

III. METHODOLOGY
The investigator selected Experimental method for the study and the design adopted for the study was Non-Equivalent Pre-Test Post-Test design [1]. This design is often used in class room experiments when experimental and control groups are such naturally assembled groups as intact classes which may be similar. One division was randomly selected as the Experimental Group and the other division as the Control Group.
The Experimental Group was taught using Abacus Technique Method while the Control Group was taught using the Present Method of Teaching.

IV. DATA ANALYSIS AND INTERPRETATION

Objective-wise analysis and interpretation is the main component of the experimentation. The data were analysed with the help of ANOVA and ANCOVA test techniques of statistics.

Comparison of Effectiveness of instructional strategy Based on Abacus Techniques over Present Method

The analysis of variance of pre test and post test scores of students in experimental and control groups showed that there is significant difference between their means (Fy =38.42; p<0.01), the experimental group being superior to the control group.

The analysis of covariance of pre test and post test scores of pupils in the experimental and control groups showed that there was significant difference between the means of the post test scores of the two groups. (Fy.x =39.10; p<0.01). The experimental group was found to be superior to the control group. (Mean of the post test scores of the experimental group is 20.88 and that of the control group is 12.27).

When the adjusted means of the post test scores of pupils in the experimental and control group were compared, the difference between them was found to be superior to the control group. (The adjusted means of post test scores of the experimental group, M_{1y,x} = 19.32 and that of the control group, M_{2y,x} =11.35, t=6.26; p<0.01).

2.1. Comparison of effectiveness of instructional strategy based on Abacus techniques over present method under the instructional objective: Knowledge

When the variance of pre test and post test scores of pupils in experimental and control groups under the knowledge category were compared, showed that there is significant difference between the post test scores of the two groups at 0.05 levels. (Fy = 4.02; p<0.05), the experimental group being superior to the control group.

The analysis of covariance of pre test and post test scores of pupils in the experimental and control groups under knowledge category, showed that there was significant difference between the means of the post test scores of the two groups is statistically significant at 0.01 level. (Fy.x = 22.38; p<0.01). The experimental group being superior to the control group.

When the adjusted means of the post test scores of pupils in the experimental and control group under the knowledge category were compared, the difference between them was found to be statistically significant at 0.01 level. (The adjusted means of post test scores of the experimental group, M_{1y,x} = 5.35 and that of the control group, M_{2y,x} =3.06, t=4.90; p<0.01).

2.2. Comparison of effectiveness of instructional strategy based on Abacus techniques over present method under the instructional objective: Understanding
When the variance of pre test and post test scores of pupils in experimental and control groups under the understanding category were compared, showed that there is significant difference between the post test scores of the two groups at 0.01 & 0.05 levels. (Fy =12.66; p<0.01), the experimental group being superior to the control group.

The analysis of covariance of pre test and post test scores of pupils in the experimental and control groups under understanding category, showed that there was significant difference between the means of the post test scores of the two groups are statistically significant at 0.01 level. (Fy.x = 13.79; p<0.01). The experimental group being superior to the control group.

When the adjusted means of the post test scores of pupils in the experimental and control group under the understanding category were compared, the difference between them was found to be statistically significant at 0.01 level. (The adjusted means of post test scores of the experimental group, M1y.x = 4.78 and that of the control group, M2y.x =3.25, t=3.77; p<0.01).

2.3. Comparison of effectiveness of instructional strategy based on Abacus techniques over present method under the instructional objective: Application

When the variance of pre test and post test scores of pupils in experimental and control groups under the application category were compared, showed that there is significant difference between the post test scores of the two groups at 0.01 level. (Fy =30.68; p<0.01), the experimental group being superior to the control group.

The analysis of covariance of pre test and post test scores of pupils in the experimental and control groups under application category, showed that there was significant difference between the means of the post test scores of the two group is statistically significant at 0.01 level. (Fy.x =21.94; p<0.01). The experimental group being superior to the control group.

When the adjusted means of the post test scores of pupils in the experimental and control group under the application category were compared, the difference between them was found to be statistically significant at 0.01 level. (The adjusted means of post test scores of the experimental group, M1y.x = 9.88 and that of the control group, M2y.x =4.94, t=4.99; p<0.01).

3. Comparison of effectiveness of instructional strategy based on Abacus techniques on numerical ability over the present method

The analysis of variance of pre test and post test scores of pupils in experimental and control groups showed that there is significant difference between their means (Fy =18.10; p<0.01), the experimental group being superior to the control group.

The analysis of covariance of pre test and post test scores of pupils in the experimental and control groups showed that there was significant difference between the means of the post test scores of the two groups. (Fy.x =22.40; p<0.01). The experimental group was found to be superior to the control group. (mean of the post test scores of the experimental group is 20.36 and that of the control group is 14.02)
When the adjusted means of the post test scores of pupils in the experimental and control group were compared, the difference between them was found to be superior to the control group. (The adjusted means of post test scores of the experimental group, $M_{1y,x} = 18.08$ and that of the control group, $M_{2y,x} = 13.51$ $t=4.78; p<0.01$).

4. Comparison of effectiveness of instructional strategy based on Abacus techniques on computation efficiency over the present method.

Before starting the experiment, a speed test was administered to both the experimental and control groups. The pre test scores obtained by the pupils in both the groups were calculated. The same test was also administered to both the groups after the experiment as post test. The scores of pre test were also calculated. The time taken by each student to complete the test was noted with the help of a stop watch. After the analysis of the time taken (in minutes) by the students, the investigator calculated the computation efficiency score. The computational speed of each student was calculated by dividing the number of correct answers in the speed test with time taken for completing it. I.e.

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\text{Computational speed} = \frac{\text{Number of correct answers in the speed test}}{\text{Time taken}}
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The computation efficiency score is calculated by multiplying computational speed and percentage of marks obtained by the student in the speed test.

The computation efficiency scores of the experimental and control group were subjected to analyzing of covariance to determine the effectiveness of abacus techniques over present method. Before calculating ANCOVA, ANOVA was done. Total sum of squares, mean square variance and F-ratio for the pre test and post test scores of the experimental and control group were computed and the results are described below.

The analysis of variance of pre test and post test scores of pupils in experimental and control groups showed that there is significant difference between their means ($F_y = 145.81; p<0.01$), the experimental group being superior to the control group.

The analysis of covariance of pre test and post test scores of pupils in the experimental and control groups showed that there is significant difference between the means of the post test scores of the two groups. ($F_{y,x} = 141.61; p<0.01$). The experimental group was found to be superior to the control group. (mean of the post test scores of the experimental group is 123.68 and that of the control group is 43.15)

When the adjusted means of the post test scores of pupils in the experimental and control group were compared, the difference between them was found to be superior to the control group. (The adjusted means of post test scores of the experimental group, $M_{1y,x} = 125.19$ and that of the control group, $M_{2y,x} = 59.61$ $t=22.95; p<0.01$).

5.1. Comparison of effectiveness of instructional strategy based on Abacus techniques on the basis of time taken for Achievement Test
The analysis of variance of pre test and post test scores of pupils in experimental and control groups showed that there is significant difference between their means (Fy =15.26; p<0.01), the experimental group being superior to the control group.

The analysis of covariance of pre test and post test scores of pupils in the experimental and control groups showed that there was significant difference between the means of the post test scores of the two groups. (Fy.x =61.05; p<0.01). The experimental group was found to be superior to the control group.

When the adjusted means of the post test scores of pupils in the experimental and control group were compared, the difference between them was found to be superior to the control group. (The adjusted means of post test scores of the experimental group, M_{y.x}^{1} = 13.18 and that of the control group, M_{y.x}^{2} =19.2; t=7.82; p<0.01).

5.2. Comparison of effectiveness of instructional strategy based on Abacus techniques on the basis of time taken for Numerical Ability Test

The analysis of variance of pre test and post test scores of pupils in experimental and control groups showed that there is significant difference between their means (Fy =11.76; p<0.01), the experimental group being superior to the control group.

The analysis of covariance of pre test and post test scores of pupils in the experimental and control groups showed that there was significant difference between the means of the post test scores of the two groups. (Fy.x =43.62; p<0.01). The experimental group was found to be superior to the control group.

When the adjusted means of the post test scores of pupils in the experimental and control group were compared, the difference between them was found to be superior to the control group. (The adjusted means of post test scores of the experimental group, M_{y.x}^{1} = 12.70 and that of the control group, M_{y.x}^{2} =18.48; t=6.60; p<0.01).

V. CONCLUSION

The present study experienced the effectiveness of an instructional strategy based on Abacus techniques on achievement and numerical ability in Mathematics at Upper Primary Level. The study has shown that Abacus techniques are more effective than Present Method of teaching on achievement in Mathematics at Upper Primary level. It is more effective in retaining the acquired knowledge for a long time than Present Method.

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