

The Effectiveness of Computer Assisted Instruction in Teaching Arithmetic

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Abstract- This True Experimental study compared academic performance of students in class VIII in one of the English Medium School of Vadodara, India among traditional instruction, only Computer Assisted Instruction (CAI) and Computer Assisted Instruction with simultaneous discussion. The design used in this study was posttest only control group design. Three sections of class VIII students were selected and groups were randomly allotted. ANCOVA was used in data analysis. There was significant difference in the post test scores of students receiving traditional method, only CAI and CAI with simultaneous discussion. Bonferroni correction was used for Post hoc test. It revealed that traditional method is as effective as only CAI. CAI with simultaneous discussion is more effective than traditional method. CAI with simultaneous discussion is more effective than only CAI.

Index Terms- Computer Assisted Instruction, Self Learning Material, Auto Instructional Method, Simultaneous Discussion and symbolic language

I. INTRODUCTION

A Significant number of students find it difficult to learn mathematics. Mathematics is a special subject symbol occupies a very important role in it. The nature of mathematics makes difficult for the students to learn. [1] Success or failure in a mathematics course has a strong influence on students' choice of major and whether they graduate and qualify for meaningful jobs. Mathematics is an abstract subject. [2]The reasoning in mathematics possesses a number of characteristics, namely, characteristics of accuracy, verification of results, certainty of results, similarity to reasoning in life, originality. All these characteristics automatically become a part and parcel of a child when he learns mathematics. Mathematics is a symbolic language. Students find it difficult to understand mathematics because of symbols and abstractness. [3]Patel in her study specifies that one of the reasons for the selection of commerce stream was that students felt science stream to be difficult, as it requires a lot of hard work to be put in. The study also stated that few of the students who earlier took up science stream later on got shifted to commerce stream, as they could not cope up with Physics and Mathematics. [4] Ours and previous few generations have failed to produce good mathematics teachers at school level in adequately large numbers. If a boy or girl is taught by a bad mathematics teacher he will be worse off than not being taught it at all. The corpus of this enormous knowledge that man built over the last few centuries will be too burdensome to carry into

future on the shoulders of ill-equipped school Mathematics teachers. Currently, Science stream is divided into group A with Mathematics and group B without Mathematics. As 21st century progresses there will be two kinds of people - mathematically abled and mathematically disabled or disadvantaged. The latter takes orders from the former. Our country requires technically skilled manpower and in order to meet this objective mathematics plays an important part. [5] In order to overcome the difficulties faced by the students, teacher should adopt different methodology in teaching of mathematics like drill method, using different audio visual aids, computer aided instruction, mathematical club etc. One of the methods is auto-instructional method. It is a method of individualized instruction. One of its forms is CAI (Computer Assisted/Aided Instruction) auto instructional teaching. It is very useful to the teachers and the students as it lessens the burden of teaching and learning and it makes teaching and learning interesting. It also helps the students to learn at their own pace and at their own convenience. It motivates the students and increases the enthusiasm of the students. In this method students read different frames and answer the questions that follow and by this way they learn automatically. Even the learning that takes place through CAI is accurate and untiring. The most beneficial part of CAI is it provides the mixture of wide range of visual, graphics and pictures to make the teaching learning more interesting. In this line investigators developed and implemented CAI and found its effectiveness.

II. RATIONALE OF THE STUDY

Many studies have been conducted on low achievements in mathematics. [6]Author have studied the low results in mathematics at Secondary Examination in Rajasthan and found that the cause of failure was non-availability of mathematics teachers due to late appointments and frequent teacher transfers; lack of appropriate classrooms. [7]Author has found the causes responsible for under achievements were gaps in knowledge of concepts, difficulties in understanding of mathematics language. These studies clearly show that students find difficulty in learning mathematics and there is a need to develop some self learning material to make learning easy. Many studies have been conducted to find out the effectiveness of CAI in terms of achievement of the students in learning. [8] Author found that experimental group performed better on post test. The studies conducted by authors [9-18] showed that CAI was effective than conventional method. [20]Author in his study found that mathematics learning through CAI with Peer Instruction (CAIPI)

was effective on posttest. [21] Author found that there was no statistically significant difference in the posttest scores of students receiving traditional instruction and traditional instruction supplemented with computer-assisted instruction. All the above stated research are conducted is subject other than mathematics. There were only three studies related to mathematics one was related to higher mathematics and other two are related to school mathematics and these two compared the traditional method and CAI. There was no research related to arithmetic part of mathematics and related to upper primary section. Investigators felt the need to conduct a research in arithmetic part of mathematic in upper primary section and with different modes.

III. METHODOLOGY OF THE STUDY

A. The Present Study Entitles

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B. Objectives of the Study

- To develop the CAI in Mathematics for Standard VIII students studying in schools affiliated to GSHSEB (Gujarat State Secondary and Higher Secondary Education Board).
- To study the effectiveness of the developed CAI in terms of students' achievement in Mathematics with one of the experimental groups (Group A) of standard VIII students.
- To study the effectiveness of the developed CAI in terms of students' achievement in Mathematics with another experimental group (Group B) of standard VIII students along with treatment of simultaneous discussion.
- To study the relative effectiveness of learning mathematics in class VIII among the three groups A, B and C (Where C is the control group and A and B are experimental groups) in terms of achievement of the students.

C. Hypotheses of the Study

- There will be no significant difference in the mean achievement scores of group C students and group A students.
- There will be no significant difference in the mean achievement scores of group C students and group B students.
- There will be no significant difference in the mean achievement scores of group A students and group B students.

D. Delimitation of the Study

The present study was delimited to standard VIII English Medium GSHSEB students and only arithmetic unit of the mathematics textbook in the year 2010 was covered during experimentation of the present study.

E. Design of the Study

The study adopts the post test only control group design.

F. Population of the Study

There are 61 grant-in-aid schools in the city of Vadodara, functioning under the Gujarat State Board of secondary and Higher Secondary Education (GSHSEB) following the rules and regulations laid by the Ministry of Human Resources of the Government of India. The population of the study consists of all the Standard VIII English medium students of GSHSEB of Vadodara city in the year 2010.

G. Sample and Procedure of the Study

One school in the urban area was selected on the basis of the computer facilities available in their campus for conducting the experiment. Random sampling technique was used to select groups by the researchers in this study. The Experimental Group A consisted of 28 students and Experimental Group B consisted of 24 students and Control Group consists of 21 students. Experimental Group A studied through the developed CAI. Experimental Group B studied through the developed CAI along with simultaneous discussions and Control Group studied through traditional method. Students in all the groups learned the same topics viz 'Profit and Loss' and 'Simple and Compound Interest' through the respective instructional strategy. Experiment time duration was 30 periods each period consisted of 35 minutes in each group for one month.

H. Tools for Data Collection

1) Computer Assisted Instruction developed by the Investigator and modified according to the advice given by experts in mathematics, mathematics education, English and Computer Science.

2) Achievement tests developed by the investigator served as pre test and post test.

I. Steps in data collection

Step 1: One of the English medium school of Vadodara, India following GSHSEB syllabus class VIII students were selected purposively having the required facility to conduct the experiment.

Step 2: Students were divided randomly into three groups control group taught by usual conventional method, Experimental Group A (only CAI) and Experimental Group B (CAI with simultaneous discussion).

Step 3: Class VII final examination mathematics marks were collected by the investigators for the purpose of calculation of ANCOVA.

Step 4: Students were taught in their respective methods for one month till the completion of the selected arithmetic unit. Control group students were taught by school mathematics teacher.

Step 5: Post test was administered to the students and their response was collected and analyzed.

IV. DATA ANALYSIS AND INTERPRETATION

[22] ANCOVA Calculation

Table 1: Calculation of ANCOVA Control Group (traditional Method)

	X	Y	X*X	Y*Y	X*Y
S.No	VII Marks out of 100	Post Test out of 100			
1	70	33.33	4900.00	1111.11	2333.33
2	54	40.00	2916.00	1600.00	2160.00
3	57	46.67	3249.00	2177.78	2660.00
4	39	53.33	1521.00	2844.44	2080.00
5	99	53.33	9801.00	2844.44	5280.00
6	37	60.00	1369.00	3600.00	2220.00
7	58	53.33	3364.00	2844.44	3093.33
8	75	46.67	5625.00	2177.78	3500.00
9	39	40.00	1521.00	1600.00	1560.00
10	37	60.00	1369.00	3600.00	2220.00
11	57	33.33	3249.00	1111.11	1900.00
12	91	46.67	8281.00	2177.78	4246.67
13	56	60.00	3136.00	3600.00	3360.00
14	77	26.67	5929.00	711.11	2053.33
15	52	33.33	2704.00	1111.11	1733.33
16	63	33.33	3969.00	1111.11	2100.00
17	51	33.33	2601.00	1111.11	1700.00
18	66	60.00	4356.00	3600.00	3960.00
19	46	40.00	2116.00	1600.00	1840.00
20	44	40.00	1936.00	1600.00	1760.00
21	74	53.33	5476.00	2844.44	3946.67
sum	1242	946.67	79388.00	44977.78	55706.67
avg	59.14	45.08			
S.D.	17.22	10.73			

Table 2: Calculation of ANCOVA Experimental Group A (only CAI)

	X	Y	X*X	Y*Y	X*Y
S.No	VII Marks out of 100	Post Test out of 100			
1	52	26.67	2704.00	711.11	1386.67
2	51	33.33	2601.00	1111.11	1700.00
3	43	40.00	1849.00	1600.00	1720.00
4	35	33.33	1225.00	1111.11	1166.67
5	43	40.00	1849.00	1600.00	1720.00
6	35	33.33	1225.00	1111.11	1166.67
7	40	40.00	1600.00	1600.00	1600.00
8	59	40.00	3481.00	1600.00	2360.00
9	38	46.67	1444.00	2177.78	1773.33
10	78	40.00	6084.00	1600.00	3120.00
11	84	60.00	7056.00	3600.00	5040.00
12	37	46.67	1369.00	2177.78	1726.67
13	90	100.00	8100.00	10000.00	9000.00
14	79	20.00	6241.00	400.00	1580.00
15	36	40.00	1296.00	1600.00	1440.00
17	69	46.67	4761.00	2177.78	3220.00
18	35	20.00	1225.00	400.00	700.00
19	81	73.33	6561.00	5377.78	5940.00
20	100	73.33	10000.00	5377.78	7333.33
21	35	40.00	1225.00	1600.00	1400.00
22	35	40.00	1225.00	1600.00	1400.00
23	46	33.33	2116.00	1111.11	1533.33
24	38	40.00	1444.00	1600.00	1520.00
25	40	46.67	1600.00	2177.78	1866.67
26	38	40.00	1444.00	1600.00	1520.00
27	93	40.00	8649.00	1600.00	3720.00
28	77	46.67	5929.00	2177.78	3593.33
sum	1487	1180.00	94303.00	58800.00	70246.67
avg	55.07	43.70			

S.D.	21.85	16.68			
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Table 3: Calculation of ANCOVA Experimental Group B (CAI with simultaneous discussion)

s.n	x	y	x*x	y*y	x*y
	vii marks out of 100	post test out of 100			
1	38	93.33	1444.00	8711.11	3546.67
2	35	80.00	1225.00	6400.00	2800.00
3	42	73.33	1764.00	5377.78	3080.00
4	41	93.33	1681.00	8711.11	3826.67
5	55	66.67	3025.00	4444.44	3666.67
6	52	73.33	2704.00	5377.78	3813.33
7	35	93.33	1225.00	8711.11	3266.67
8	64	73.33	4096.00	5377.78	4693.33
9	36	60.00	1296.00	3600.00	2160.00
10	96	100.00	9216.00	10000.00	9600.00
11	40	60.00	1600.00	3600.00	2400.00
12	55	66.67	3025.00	4444.44	3666.67
13	44	73.33	1936.00	5377.78	3226.67
14	95	100.00	9025.00	10000.00	9500.00
15	45	73.33	2025.00	5377.78	3300.00
16	61	60.00	3721.00	3600.00	3660.00
17	35	46.67	1225.00	2177.78	1633.33
18	56	46.67	3136.00	2177.78	2613.33
19	42	60.00	1764.00	3600.00	2520.00
20	94	93.33	8836.00	8711.11	8773.33
21	93	60.00	8649.00	3600.00	5580.00
22	48	66.67	2304.00	4444.44	3200.00
23	76	80.00	5776.00	6400.00	6080.00
24	100	100.00	10000.00	10000.00	10000.00
sum	1378	1793.33	90698.00	140222.22	106606.67
avg	57.42	74.72			

Table 4: ANOVA table for Adjusted X

Source	d.f.	SS	MS	F-Ratio
Between groups	2	2972.085	1486.043	3.880082
Within groups	68	26043.49	382.9926	
Total	70	29015.58		

Table 5: Result of One-Way ANCOVA

ANCOVA Results (k=3)						
	Source	SS	df	MS	F	P
	adjusted means	14643.36015	2	7321.68008	37.516212	0.00000000010
	adjusted error	13270.90918	68	195.160429		
	adjusted total	27914.26934	70			
Test for Homogeneity of Regressions						
	Source	SS	df	MS	F	P
	between regressions	904.9218154	2	452.460908	2.4880619	0.090605826
	remainder	12365.98737	68	181.852755		

Table 6: Adjusted Means of the respective groups

	CV Observed	DV Observed	Adjusted	Group
Means				
1	57.41666667	74.72222	74.61422	EXP B
2	55.07407407	43.7037	44.27039	Control
3	59.14285714	45.07937	44.4742	Exp A

At 5% level, the table value of F for $v_1 = 2$ and $v_2 = 68$ is 3.132 this value is less than the calculated value (i.e. calculated value of 37.516 is greater than table value) and accordingly we infer that F-ratio is significant at 5% level which means the difference in group means is significant.

At 1% level, the table value of F for $v_1 = 2$ and $v_2 = 68$ is 4.92 this value is less than the calculated value (i.e. calculated

value of 37.516 is greater than table value) and accordingly we infer that F-ratio is significant at 1% level which means the difference in group means is significant.

Adjusted Mean of Experimental Group B(74.61422) with discussion is more than the other two groups namely Experimental Group A(44.4742) and Control Group(44.27039).

[23] Post test results (Bonferroni correction) at 5% level

Table 7: Mean and size of the sample of the respective groups

Comparison	Mean 1	Mean 2	N1	N2
1: Control GP and Exp A	+ 45.08	+ 43.70	21	28
2: Control GP and Exp B	+ 45.08	+ 74.72	21	24
3: Exp A and Exp B	+ 43.70	+ 74.72	28	24

Mean Square= 382.9926 DF= 68

Table 8: Calculation of confidence intervals

Comparison	Mean1 - Mean2	95% CI of difference
1: Control GP and Exp A	+ 1.38	- 12.49 to + 15.25
2: Control GP and Exp B	- 29.64	- 43.99 to - 15.29
3: Exp A and Exp B	- 31.02	- 44.38 to - 17.66

Table 9: Comparison of Statistical Significance of three groups

Comparison	Significant? (P <0.05?)	t
1: Control GP and Exp A	No	0.244
2: Control GP and Exp B	Yes	5.069
3: Exp A and Exp B	Yes	5.698

At 5% level of significance

1. There is no significant difference between the mean achievement scores of Control Group students and Experimental Group A (Only CAI) students.

This shows that both the methods that is teaching by traditional method is as effective as teaching by only CAI.

2. There is significant difference between the mean achievement scores of Control Group students and Experimental Group B (CAI with simultaneous discussion) students.

From the above result it can be concluded that there is significant difference between teaching by traditional method and CAI with simultaneous discussion. Mean achievement score of students taught by CAI with simultaneous discussion is more than mean achievement score of students taught by traditional

method. Therefore CAI with simultaneous discussion is more effective than traditional method.

3. There is significant difference between the mean achievement scores of Experimental Group A (Only CAI) students and Experimental Group B (CAI with simultaneous discussion) students.

From the above result it can be concluded that there is significant difference between teaching by only CAI and CAI with simultaneous discussion. Mean achievement score of students taught by CAI with simultaneous discussion is more than mean achievement score of students teaching by only CAI. Therefore CAI with simultaneous discussion is more effective than only CAI.

[23] Post test results (Bonferroni correction) at 1% level

Comparison	Mean 1	Mean 2	N1	N2
1: Control GP and Exp A	+ 45.08	+ 43.70	21	28
2: Control GP and Exp B	+ 45.08	+ 74.72	21	24
3: Exp A and Exp B	+ 43.70	+ 74.72	28	24

Mean Square= 382.9926 DF= 68

Confidence intervals

Comparison	Mean1 - Mean2	99% CI of difference
1: Control GP and Exp A	+ 1.38	- 15.81 to +18.57
2: Control GP and Exp B	- 29.64	- 47.43 to -11.85
3: Exp A and Exp B	- 31.02	- 47.58 to - 14.46

Statistical Significance

Comparison	Significant? (P <0.01?)	t
1: Control GP and Exp A	No	0.244
2: Control GP and Exp B	Yes	5.069
3: Exp A and Exp B	Yes	5.698

At 1% level of significance

1. There is no significant difference between the mean achievement scores of Control Group students and Experimental Group A (Only CAI) students.

This shows that both the methods that is teaching by traditional method is as effective as teaching by only CAI.

2. There is significant difference between the mean achievement scores of Control Group students and Experimental Group B (CAI with simultaneous discussion) students.

From the above result it can be concluded that there is significant difference between teaching by traditional method and CAI with simultaneous discussion. Mean achievement score of students taught by CAI with simultaneous discussion is more than mean achievement score of students taught by traditional

method. Therefore CAI with simultaneous discussion is more effective than traditional method.

3. There is significant difference between the mean achievement scores of Experimental Group A (Only CAI) students and Experimental Group B (CAI with simultaneous discussion) students.

From the above result it can be concluded that there is significant difference between teaching by only CAI and CAI with simultaneous discussion. Mean achievement score of students taught by CAI with simultaneous discussion is more than mean achievement score of students teaching by only CAI. Therefore CAI with simultaneous discussion is more effective than only CAI.

V. FINDINGS OF THE STUDY

From the data analysis it can be concluded that teaching students of class VIII the arithmetic part of mathematics by traditional method is as effective as only CAI. Teaching students by CAI with simultaneous discussion is more effective than traditional method that is traditional method should be supplemented by self learning material like CAI so that maximum learning takes place. Teaching students by CAI with simultaneous discussion is more effective than only CAI that is presence of teacher is essential so that students can clear their doubts arising while learning.

VI. EDUCATIONAL IMPLICATION OF THE PRESENT STUDY

Students enjoyed learning mathematics through CAI and it helped students as a supplementary material. Self learning material should be developed in mathematics where ever possible for all classes and should be used along with the conventional method to make learning enjoyable pleasant experience.

VII. CONCLUSION

The results of this study indicate that class VIII students learned mathematics equally well with or without CAI. The mere presence of computers does not improve student learning. Computers have the potential to be useful tools to improve learning; however, it is the responsibility of the teachers to choose software that meets the needs of the students, to use it effectively, and to require its use. Educators can tap into this interest by using technology to deliver instruction and assess learning. Computer learning systems provide educators the opportunity to create lessons in a variety of alternative formats to the traditional lecture in order to address the different learning styles and preferences of students. And this supplement is also useful to the students whenever they are absent to the class during the content is taught. They can refer repeatedly until they understand thoroughly this facility is absent in the traditional method. Ultimately quality is essential in any mode of instruction. There is also limitations in preparing CAI person should know not only the content but also methods to prepare CAI.

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