Appendix 4 Research Paper Published in the Referred Journals

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S.No	Journal Name	Article Name
1	International Journal of Scientific and Research Publications	The Effectiveness of Computer Assisted Instruction in Teaching of Arithmetic
2	Journal of Computing Technologies	The Effectiveness of Computer Assisted Instruction in Teaching of Arithmetic Final Tryout
3	Journal of Humanities and Social Science	Computer Assisted Instruction in Teaching of Mathematics
4	Abstracts of Educational Research Studies in India	Using Compatible Research Methodology in Social Science
5	Journal of Humanities and Social Science	Comparative Analysis of Reaction of Students on Final Version of Computer Assisted Instruction for Teaching Arithmetic with Different Modes
6	Indian Journal of education Research Experimentation and Innovation	Students' Reaction on Computer Assisted Instruction for Teaching and Learning Arithmetic

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 ot shifted to commerce stream, as they could not cope up with physics and Mathematics. [4] Ours and previous few generations ave failed to produce good mathematics teachers at school level i 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 t all. The corpus of this enormous knowledge that man built ver 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

The Effectiveness of Computer Assisted Instruction in Teaching Arithmetic

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 con-ducting 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)

S.No	X	Y	X*X	Y*Y	X*Y
	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)

S.No	X VII Marks out of 100	Y Post Test out of 100	X*X	Y*Y	X*Y
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 | | | |

Table 3: Calculation of ANCOVA Experimental Group B (CAI with simultaneous discussion)

s.n	x vii marks out of 100	y post test out of 100	x*x	y*y	x*y
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	0.000000000010
	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		Group
Means			Adjusted	
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 v1 = 2 and v2 = 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 v1 = 2 and v2 = 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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The Effectiveness of Computer Assisted Instruction in Teaching of Arithmetic Final Tryout

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Abstract— **This study is the continuation of initial tryout conducted in one of the English Medium school of Vadodara, India. Computer Assisted Instruction (CAI) is modified after initial tryout and used for final tryout. Investigators have selected arithmetic part of class VIII Gujarat State Secondary and Higher Secondary Education Board (GSHSEB) text book and Computer Assisted Instruction was developed in this part. This True Experimental study compared academic performance of students in class VIII in one of the English Medium School of Vadodara following GSHSEB textbook, India among conventional method, 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. The findings of the study showed that there was no significant difference between the mean achievement post test scores of students receiving traditional method, only CAI and CAI with simultaneous discussion.**

Keywords— **Abstract Subject, Auto Instructional Method, Computer Assisted Instruction, Conventional Method Self Learning Material, Simultaneous Discussion and Symbolic language.**

I. INTRODUCTION

Teaching and learning mathematics is a challenge because mathematics is a special subject where in symbols occupy an important position. Nature of mathematics is abstract and has a special language called symbolic language. Most of the students find difficult in learning mathematics because of its nature. If a student fails to learn the basic concepts of mathematics it will affect his future career. [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 a theoretical 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. Patel [3] 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.

[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. In CAI is prepared using psychological theories of learning. Mastery learning can be facilitated through programmed learning. The fundamental notion of programmed learning is that reinforcement of learning. Programmed learning is applied through electronic self-learning modules with built in feedback, remediation, and reinforcement of learning. A self-learning module is a self-contained unit or package of study materials, which students study on an individual basis. Students proceed through a pre-test, learning outcomes, content, and activities, post-test. Successful completion of one level of learning is required to proceed to a higher level. CAI supports student-centered learning. It is mediator between information-communication technologies and theories of learning. In this line investigators developed and implemented CAI and found its effectiveness.

II. RATIONAL OF THE STUDY

Investigators have reviewed two studies related to low achievements in mathematics. Jain, and Burad [6] 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. Chel[7] 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. Investigators have reviewed fourteen studies related to CAI. Jeyamani[8] found that experimental group performed better on post test. The studies conducted by authors [9],[10],[11],[12],[13],[14],[15],[16],[17],[18]showed that CAI was effective than conventional method. Vansia[20] in his study found that mathematics learning through CAI with Peer Instruction (CAIPI) was effective on posttest. Spradlin, Kathy Dye and Ackerman, Beth[21] 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. Barad[22] found that science teaching through CAI programme was more effective for boys than girls in rural area. Out of fifteen studies reviewed related to CAI there were only three studies related to mathematics. One was related to higher mathematics and other two were related to school mathematics and these two schools related studies 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. [23] Investigators have conducted the research in initial tryout the title of the study is "Effectiveness of Computer Assisted Instruction in Teaching Arithmetic" and found that there was significant difference between students' learning through only computer assisted instruction, conventional method and CAI with simultaneous discussion. CAI was modified after initial tryout and modified CAI was used for the present study (final tryout).

III. METHODOLOGY OF THE STUDY

A. *The Present Study Entitles*

The Effectiveness of Computer Assisted Instruction in Teaching Arithmetic Final Tryout.

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 between the mean achievement scores of group C students and group A students.
- There will be no significant difference between the mean achievement scores of group C students and group B students.
- There will be no significant difference between 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 33 students, Experimental Group B consisted of 32 students and Control Group consists of 32 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*

Achievement tests developed by the investigator served as initial 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: Initial test in mathematics prepared by the investigators was administered to the students and their marks were collected by the investigators for the purpose of calculation of ANCOVA.

Step 4: Students were taught in their respective methods 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 marks was collected and analyzed.

IV. DATA ANALYSIS AND INTERPRETATION

[22] ANCOVA Calculation

TABLE 1
ANOVA Table for Adjusted X

Source	d.f.	SS		
Between groups	2	380.6043	190.3021631	0.800956778
Within groups	93	22096.2	237.5935485	
Total	95	22476.8		

At 5% level, the table value(table 1) of F for v1 = 2 and v2 = 93 is 3.094 this value is more than the calculated value (i.e. calculated value of 0.800956778) and accordingly we infer that F-ratio is not significant at 5% level which means the difference in group means is not significant. There is no significant difference between the Control group, Experimental group A(only CAI) and the Experimental Group B(CAI with discussion). All these three methods of teaching are equally same.

TABLE 2
Result of One-Way ANCOVA

Source	SS	df	MS	F	P
adjusted means	188.30	2	94.15	0.21	0.811124672
adjusted error	41732.88	93	448.74		
adjusted total	41921.17	95			

Table 2 shows the result of One-Way ANCOVA p value is approximately 0.811 which means that null hypotheses is not rejected.

TABLE 3
Test for Homogeneity of Regressions

Source	SS	df	MS	F	P
between regressions	1185.90	2	592.95	1.36	0.261714201
remainder	40546.98	93	435.99		

Table 3 shows the result for homogeneity of Regression, F value is 1.36 which is very close to 1 therefore the groups are homogeneous.

TABLE 4
Adjusted Means of the respective groups

Group	CV (Maths marks before treatment)	DV (Post Test Marks)	
Means	Observed	Observed	Adjusted
EXP A	79.39	75.61	76.30
control	83.96	74.38	73.57
EXP B	81.25	76.67	76.75

Table 4 shows the calculation of adjusted means of the Control Group, Experimental Group A (only CAI) and Experimental Group B(CAI with simultaneous discussion).
(CV –Concomitant Variable DV- Dependent Variable)

V. FINDINGS OF THE STUDY

From the data analysis it can be concluded that teaching students of class VIII the arithmetic part of mathematics is equally effective for traditional method, only CAI and CAI with simultaneous discussion.

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. CAI is equally effective with or without the presence of teacher and it is as effective as usual conventional method. Therefore in case of non-availability of teacher or due to some reason teacher is not present for few days or in any such incident students can learn mathematics by themselves.

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.

ACKNOWLEDGMENT

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Computer Assisted Instruction in Teaching of Mathematics

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Abstract : *Mathematics is an abstract subject and symbol occupies an important position. Students find it difficult to comprehend this subject. There are many failures in mathematics than any other subject. Considering student teacher ratio and heterogeneous group of students in a normal classroom it is very difficult for a teacher to reach to all the students. Hence there is a need of supplement along with classroom teaching. Computer assisted instruction plays very important role in this situation. This paper explains the nature and importance of mathematics and Computer assisted instruction and its importance.*
Keywords — *Abstract, Computer Assisted Instruction, Heterogeneous Groups, Individualized Instruction, Special Language*

I. INTRODUCTION

"Education has always been important but perhaps, never more so, in man's history than today. In a science based world, education and research are crucial to the development process of a country, its welfare, progress and security" [1]

This statement is more relevant even after forty-six years in today's world of knowledge explosion but rather increased. The 21st century world can be called a scientific world, advancing rapidly in information technology, medicine, engineering, space communication, astronomy, astrophysics, artificial intelligence, robotics and many other disciplines. Our country requires technically skilled manpower. For all disciplines mathematics is the base. The syllabus of mathematics at secondary level that is currently in use has been prepared by NCERT and is known as new pattern syllabus.

Mathematics is an abstract subject. 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 has a special language in which symbol occupies an important position. Students find it difficult to understand mathematics because of symbols and abstractness. [2] 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 Education Commission (1964-66) recommended mathematics as a compulsory subject for all school students. Thus, mathematics enjoys a unique status in a school curriculum. [3] The National policy on Education NPE- 1986 also emphasizes that mathematics should be visualized as the vehicle to train a child to think, reason, analyze and articulate logically, apart from being a specific subject it should be treated as concomitant to any subject involving analysis and reasoning. Yet many school students find difficulty with learning of mathematics and fail in mathematics. A major reason for the failure is that the teachers quite often pay no attention to the basic concepts and generally adopt methods of solving questions with crammed up formulae. [4] "Ours and previous few generations have failed to produce good mathematics teachers at school level in adequately large numbers." 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. This is so since teaching mathematics to impressionable young minds is a specialized task that many mathematicians may not measure. Mathematics is a hard task master that demands implicit and whole attention from the disciple.

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. This aspect is elaborated in topics that follow.

1.1 Importance of Mathematics

Epistemologically mathematics means mathema- explaining and understanding, tics- techniques such as counting, ordering, sorting, and measuring. Right from pre historic period there have been problems to solve. Problems may be over basic requirements like food, water, shelter or accomplishment like constructing multi-

storied building. In this modern era we cannot think of a field, where calculation or computation is not used. Knowingly or unknowing we use mathematics in our day-to-day life. It ranges from household to industries, business, education, science and technology, art and craft and even in music, dance etc.,

1.2   Nature of Mathematics

Mathematics relies on both logic and creativity, and it is pursued both for a variety of practical purposes and for its intrinsic interest. Language of mathematics is symbolic and less verbose. Mathematics is the science of patterns and relationships.

[5] "Mathematics is the science of number and space. Mathematics is the science of measurement, quantity and magnitude. Mathematics is also called science of logical reasoning. Mathematics may also be defined as the science of abstract and imaginative form."

Education Commission (1964-65) "One of the outstanding characteristics of science culture is qualification of Mathematics".

- Mathematics is hierarchical in nature.
- Mathematics is science of logical reasoning.
- Mathematics is more than computation
- Mathematics has peculiar language and symbolism. It has a different language and syntax and uses many words from day today life but in different sense.
- Mathematics is abstract in nature.

According to [6] characteristics of Mathematics is listed as follows:

- It is the science of number and space.
- It is the science of calculation.
- It is the science of measurement, quantity and magnitude.
- It is systemized, organized and exact branch of science.
- It deals with quantitative facts and relationship.
- It is the abstract form of science.
- It is science of logical reasoning.
- It settles in the mind the habit of reasoning

II.   CAI IN LEARNING MATHEMATICS

ICT (Information and Communication Technology) has great potential for teaching and learning process at all levels. The use of ICT has enriched the teaching learning process with the help of computer. It has brought a great change, innovativeness, and creativity in teachers in teaching learning process. Mathematics and computer are both important in today's life as they open the gate of ample opportunities in this modern world. Mathematics is widely used in computers both in hardware and software. Computer helps in improving the knowledge of mathematics. Computer helps in making classroom teaching lively.

Computer can play vital role in learning process as it can work with the imagination of students. Any concept in mathematics can be explained with the help of pictures and this visual image can help in understanding the concept at ease. In paper pencil method student can get bored easily and can find it difficult to practice the sum again and again. CAI works as a change and increases the curiosity of students and they can learn interestingly without any difficulty. Also whatever is learnt through computer aided instructions, the contents can be retained for longer time as they use more senses of the students. Certain chapters like Profit and loss, Simple and compound interest can be explained very easily using CAI. Varity of exercises can be provided and this ensures active involvement of the students. The material can be provided according to the needs of the students.

2.1 Advantages of CAI in learning Mathematics

In this age of technology the teacher should be aware of student's need. CAI can help to satisfy the needs of the students. CAI lessens the workload of the teachers, besides it has many other advantages as given below

- Provides Wide Range Of Experiences
  CAI helps the teacher to provide a wide range of experience s/he can give many examples and illustrations and can make the concept clear.
- Provides Motivation
  It can sustain the motivation of the students as the topic can be presented in an enjoyable manner as concepts can be presented systematically, interestingly and immediate feedback can be given which sustains the motivation of the students. Graphics and pictures can be presented which can attract and retain student attention. Children get reinforcement when they answer the question correctly and the topic is presented in a systematic manner in an increasing order of difficulty.

- Individualized Instruction
  CAI is an individualized instruction as it caters to the individual difference. Some students are slow learners and some are fast learners. The Indian classroom is a heterogeneous group. Some students need more time to learn while others need less time, so learning speed differs from learner to learner. CAI also provides different learning experience according to the understanding level of the students. It also provides facilities like selecting the topics of their own interest. It provides individual attention to each and every student and thus enhances the quality of teaching learning process and thus we can overcome the problems faced in a overcrowded classroom.
- Interactive Learning
  CAI provides immediate feedback to the students and thus constantly interacts with them. In CAI students actively take part in the learning process. As it contains many examples and diagrams it makes the learning process interesting.

1.2 Principles of CAI
Principle of CAI is same as PLM
- Principle of small steps
- Principle of active responding
- Principle of reinforcement
- Principle of self-pacing
- Principle of student –evaluation or student testing

2.3 Characteristics of CAI
   CAI refers to any use of computers that interacts with students in any way in the educational process.
- Practice: CAI enables the students to practice as many times as they like so this will enable them to achieve the required competencies. Students come from different background it is a heterogeneous group so their understanding level differs from student to student so a single teacher cannot cater such heterogeneous group so there is a need of right learning tool and a supporting environment. Practice makes a man perfect. Many psychologists like Thorndike support the usefulness of practice in learning.
- Immediate feedback: CAI enables the students to see the correct answer immediately as soon as they answer a particular question so that they can correct themselves. If the answer is correct then they will get immense happiness and added confidence. If the answer is wrong they can correct themselves immediately. In traditional classroom teaching, teacher gives students homework for practice. The child comes to know of any mistake when the teacher checks the homework and corrects the mistake. Normally teachers do not provide the correct answer during checking, so child knows that his answer is wrong but does not know the correct answer. If the teacher does sometimes provide the correct answer, the child may not pay due attention to the corrected answer and may consider it as a part of his work is to complete the homework and would proceed with the next homework.
- Self-Evaluation: CAI enables the students to find their strengths and weakness and student can overcome his weakness before proceeding further.
- Reinforcement: CAI reward students immediately whenever they answer the question correctly immediate reinforcement gives immense pleasure as indicated by many psychologists.
- Immediate Evaluation: As soon as each concept is completed students should answer questions related to that particular concept this enables immediate evaluation.

III. LIMITATIONS OF PREPARING CAI
- Constructing a program needs a highly specialized skill.
- The author should have thorough knowledge of the subject matter and of programming techniques.
- The steps should proceed in a more sequential and illustrative examples should be selected carefully so that error-rate of a learner has to be minimized. If the learner commits more error then he will be de motivated.
- It consumes more time.

IV. NECESSITY OF CAI
- To achieve mastery learning
  Mastery is a recent innovation introduced in the sphere of education. Mastery learning implies a systematic approach to the process of teaching or instruction.
- Individual differences

Each and every child is different. In a classroom teacher teaches to a group of students. Some students are slow learners, some are medium, and some are gifted. Classroom group is a heterogeneous group they come from different family background and with different interest. Some are extrovert and some are introvert.

- To make learning continuous.

  When the child is absent on the previous day he cannot understand the lesson taught on that day because of lack of continuity and whatever is taught on that day he finds difficult to comprehend. CAI helps him to understand the concept without any difficulty whenever he misses a class.

- Span of attention

  The time span the student remains attentive in a class. This is different for different students.
  Definition of attention

[7] "Attention may be described as the selective activity of the human organism whereby one's consciousness is focused upon a specific, narrow field to the exclusion of everything else in the environment."

V. CONCLUSION

In a typical mathematics classroom we can observe that teacher spends approximately 5 minutes for introduction, 15 to 20 minutes for content explanation, 10 to 15 minutes for question and answers to heterogeneous group's verification and confirmation either at the end or continuously along with teaching. Thereafter, the teacher recapitulates all the subtopics. It is not possible to interact with all students, so teacher interacts with about 4 to 5 students. Having confirmed that these 4 to 5 students have understood the content explanations, the teacher assumes that the entire class has followed the content. Some students are mere spectators because they did not get a chance to answer. In this process teacher cannot cater to slow learners, obviously the teacher does not have time. This is not the teacher's fault but the system's fault. Certain students cannot grasp the contents fully. So it is not possible for the teacher to cater to all the students. Certain methodology and supporting methods are needed hence there is a need for development of CAI in mathematics. Certainly students cannot learn the entire topics by themselves using CAI, teachers roll is very important therefore CAI can be used as a supplement along with the teachers teaching.

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Using Compatible Research Methodology in Social Science

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Vadodara

1. Introduction

Social research refers to research conducted by social scientists, which follows a systematic plan. Social science research can be broadly classified into qualitative and quantitative or a combination of these two. Social scientists employ a wide range of methods in order to analyse the data, from census survey derived from millions of individuals to in depth study like case study. Social scientist can be divided according to the research techniques they support. These disputes are related social theories like positivism and anti positivism; structure and agency. Sampling is another concern whether to follow positivistic approach like statistics derived from a sample are analysed in order to draw inferences regarding the population as a whole. In that case what sampling methods to adapt random sampling or non-random sampling. Social science research generally attempts to create or validate theories through data collection and data analysis and its goal is exploration, description, explanation and prediction. Social research aims to find social patterns of regularity in social life and usually deals with social groups. Data analysis is the heart of any research and the methods used in data analysis determines the usefulness of the research done. In all research there is inference and conclusion. Therefore we can understand the usefulness of research methodology used in any social science research. Research methodology used in social science is borrowed from other discipline therefore it cannot be compatible to social science. There is a dire need to evolve own methodology in social science.

2. Foundations of Social Research

The origin of the survey can be traced back at least early as the Domesday Book in 1086. Some scholars believe that the origin of Demography as 1663 with the publication of John Graunt's Natural and Political Observations upon the Bills of Mortality. But the social science research became more intensively after positivistic philosophy of science in the early 19th century. The formal academic discipline of sociology began after the work of Emile Durkheim (1858-1917). (Wikipedia, Paul Lazarsfeld, 2013) Paul Felix Lazarsfeld (February 13, 1901 – August 30, 1976) was one of the major figures in 20th-century American sociology. The founder of Columbia University's Bureau of Applied Social Research, he exerted a tremendous influence over the techniques and the organization of social research. His many contributions to sociological method have earned him the title of the "founder of modern empirical sociology".

3. Designs in Social Science research

Social research methods can generally vary from qualitative and quantitative dimension. (Wikipedia, Social Research, 2013)Quantitative designs approach social phenomena through quantifiable evidence, and often rely on statistical analysis of many cases (or across intentionally designed treatments in an experiment) to create valid and reliable general claims related to quantity. Qualitative designs emphasize understanding of social phenomena through direct observation, communication with participants, or analysis of texts, and may stress contextual and subjective accuracy over generality related to quality. While various methods may sometimes be classified as quantitative or qualitative, most methods contain elements of both. For example, qualitative data analysis often involves a fairly structured approach to coding the raw data into systematic information, and quantifying inters coder reliability. Thus, a strong distinction between "qualitative" and "quantitative" should really be seen as a somewhat more complex relationship, such that many methods may be both qualitative and quantitative.

(Gautam, Sharma, & Gautam, 2007) the researchers suggested some models with reference to context(variables, sample, population etc) of specific research study/problem. These models are combinations of Qualitative and Quantitative research and they are as follows:

Combination of Qualitative and Quantitative research

Model 1

Pre-study Model

| A Qualitative Pre-study: Generating Hypothesis | → | Quantitative Verifying Hypothesis | → | Results |
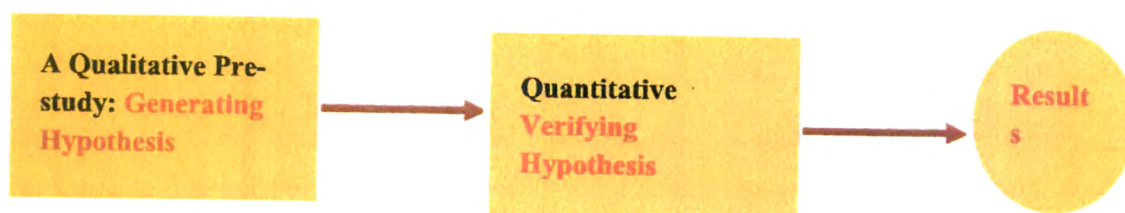
In this model a qualitative research is conducted first before the actual research. This exercise is done in order to generate hypotheses. It is followed by actual research in order to verify the hypotheses, in this process the result is generated. Suppose a researcher wanted to find the effectiveness of a new programme he has developed. If he conducts the qualitative research in order to generate the hypotheses then he conducts quantitative research in this way he gets result. This type of study is known as Pre-study model.

Model 2

Generalization- Model

| Qualitative — Issue Oriented Descriptive Study | → | Result | ← | Quantitative — Generalization Context Analysis |
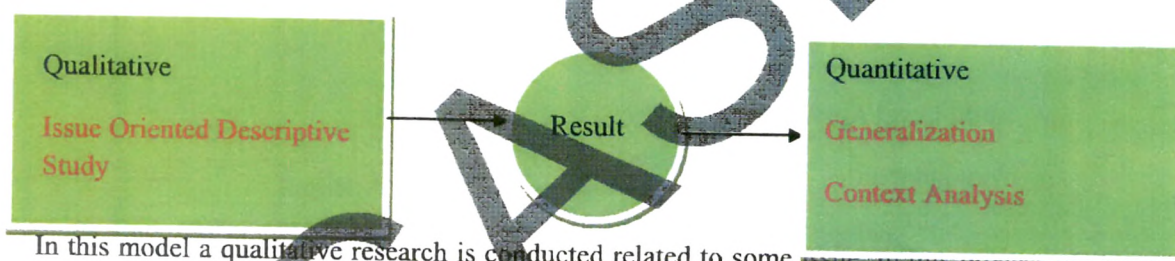
In this model a qualitative research is conducted related to some issue. In this process the result is generated. This is followed by a quantitative research in order to generalize the result to a larger group. Suppose a researcher conducts a descriptive study on a small group of people facing some problem over an issue. This will end up in some result. Same study is conducted to a larger group and generalization is done for the larger group.
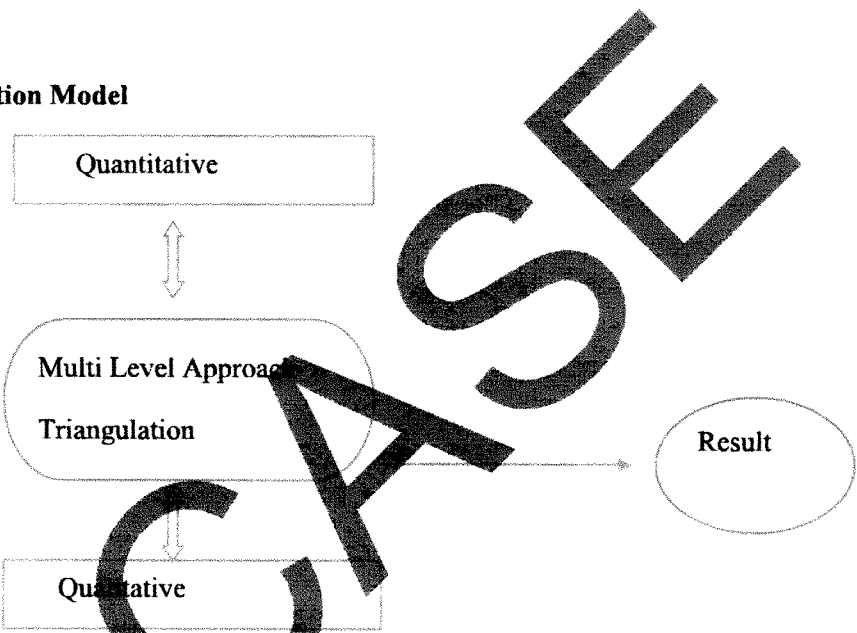
Model 3

Consolidation Model

| Quantitative — Study on a Large Sample | → | Result | → | Qualitative — Interpretation, Correlation, Explanation, Consolidation, Case Study |
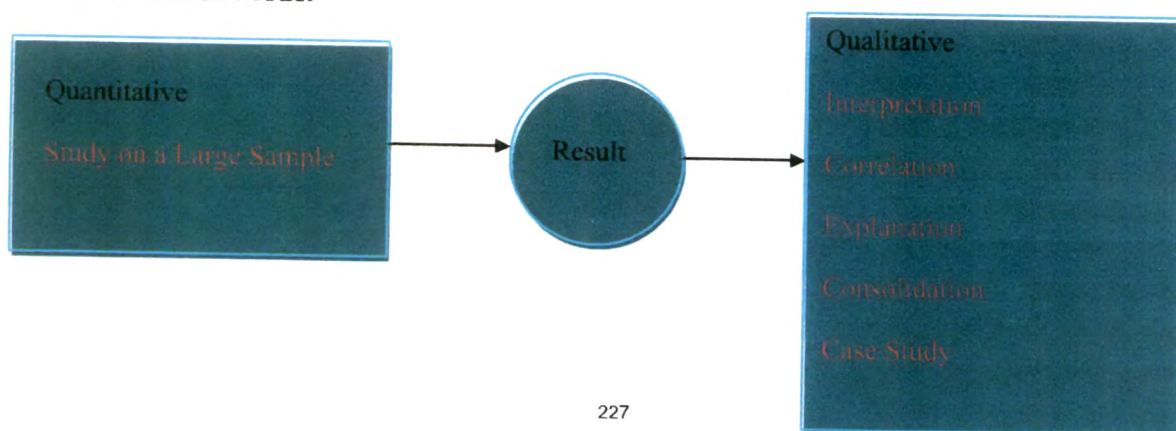
In this model a quantitative study is conducted for a large sample and result is obtained in this process. This is followed by a qualitative study like case study, correlation etc. in order to consolidate the result obtained. Suppose a researcher develops a new method of teaching and tests the effectiveness of the developed method on sample and inference is made about population using inferential statistics. Then he does follow up by testing the result by selecting small group using case study using qualitative technique this method is called consolidation model.

Model 4

Triangulation Model

In this model researcher conducts a study using qualitative as well as quantitative technique i.e., he uses multi level approach in order to arrive at a result. Suppose a researcher conducts a study using all possible angle and direction in order to arrive at a result this method is called triangulation model.

4. Guidelines for "good research"

When social scientists speak of "good research" the guidelines refer to how the science is mentioned and understood. It does not refer to how what the results are but how they are figured. (Wikipedia, Glenn Firebaugh, 2012)Firebaugh summarizes the principles for good research in his book Seven Rules for Social Research.

Rule (1) there should be the possibility of surprise in social research.

Rule (2) Good research also will "look for differences that make a difference.

Rule (3) Build in reality checks

Rule (4) advises researchers to replicate, that is, "to see if identical analyses yield similar results for different samples of people.

Rule (5) to compare like with like.

Rule (6) to study change. (Rule (5) and (6) are especially important when researcher want to estimate the effect of one variable on another)

Rule (7) **"Let method be the servant, not the master,"** reminds researchers that methods are the means, not the end, of social research; it is critical from the outset to fit the research design to the research issue, rather than the other way around.

5. Need for Change to Obtain Compatible Methodology in Social Science Research

Social Scientist sometimes uses methodologies that are not exactly matching with their problem. They use methodologies that are ready made available and no modification is done according to their need. Especially in experimental type of study control becomes an important part. There should be balance between internal and external validity in establishing this validity sometimes they keep problem in secondary position (External Validity, 2013)Both internal and external validity are not captured in a single experiment.

Another problem social scientist is facing is getting the permission from the authorities. Sometime after selecting the sample by using certain sampling technique they may not get permission from the authorities to conduct the research. They are forced to conduct experiment wherever they are getting permission. Suppose a researcher after adopting stratified random sampling techniques selected some schools for conducting experiment. If s/he finds that authorities from the selected schools are not ready to give permission then s/he finds it difficult to proceed his/her research further. S/he cannot compel the school authorities to give permission because s/he selected the school randomly. Rule (7) given by Glenn Firebaughcan can be used in this situation.

In social science research, experiment is done with human beings; therefore their cooperation is very important. In many cases we include subject without their consent. Suppose a school gives

permission to carry out certain research then all students selected for the study are compelled to be subject of the study. But students/subjects should not be compelled like this; even their permission for cooperation should be made compulsory. In some developing and developed countries getting permission from subject is mandatory. (U.S. Department of Health & Human Services, 2010)Except as provided elsewhere in this policy, no investigator may involve a human being as a subject in research covered by this policy unless the investigator has obtained the legally effective informed consent of the subject or the subject's legally authorized representative. An investigator shall seek such consent only under circumstances that provide the prospective subject or the representative sufficient opportunity to consider whether or not to participate and that minimize the possibility of coercion or undue influence. The information that is given to the subject or the representative shall be in language understandable to the subject or the representative. No informed consent, whether oral or written, may include any exculpatory language through which the subject or the representative is made to waive or appear to waive any of the subject's legal rights, or releases or appears to release the investigator, the sponsor, the institution or its agents from liability for negligence.

Sometimes social scientist gets some result after data analysis which they did not expect like there is no significant difference between the methods used. That is the new method the researcher developed is as effective as the existing method. Researcher becomes upset and thinks that the new method they developed may not be good. But there are possibilities that subject did not want to change the mindset that is according to them old method is the best and they might have responded accordingly. Unidirectional approach should be avoided data should be collected in multidirectional and then only we can conclude. Sometimes because of this unidirectional approach we may conclude that the new method that the social scientist developed is not effective. But there may be possibility if the researcher conducted the research in multidirectional result might be different. Holistic approach should be used to solve a problem and should be viewed in all possible direction. That is different set of data should be collected from the same sample and hypotheses should be verified accordingly to arrive at final result. Social scientist should be given freedom to conducts multidirectional approach. If researcher opts for multidirectional approach they don't know how to collate the results obtained by such methods because there are few literatures which discusses such methods.

Therefore research methodologies should be developed according to the need of the social scientist. They should be allowed to mix methodologies and modify it according to the need of their problem.

6. Conclusion

- Social scientist face genuine problem because they are using humans as their subject.
- They borrow methodologies from outside which may not be appropriate
- There is a dire need to develop methodologies compatible to social science.
- Modifications in the existing methodologies should be allowed according to the specific problem and should not be compelled to use the existing methodologies.
- Methodologies can be mixed and a new can be formed according to the specific need of social scientist.
- Need of multidirectional approach in social science research

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Comparative Analysis of Reaction of Students on Final Version of Computer Assisted Instruction for Teaching Arithmetic with Different Modes

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ABSTRACT: Investigators conducted a True Experimental study to compare the 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. Students studied through their respective methods till the completion of the selected topic. Reaction scale was developed and administered to the experimental group students to know their opinion on the developed CAI. Chi-square was used for data analysis. The analysis revealed that students liked their respective way of learning.

Keywords — Abstract, Auto Instructional Material, Computer Assisted Instruction, simultaneous discussion and Symbolic Language.

I. INTRODUCTION

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. As the twenty first century advances we need technically skilled human resource to take up new job opportunities. Mathematics is important to develop human resource in this direction. Students find it difficult to learn mathematics because of the nature of the subject. [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. Investigators developed CAI and found its effectiveness in one of the school of Vadodara. CAI was modified and final version was prepared according to the comments of students, Mathematics teachers and investigators observation. The final version was used in the experiment conducted in another school of Vadodara, India.

II.   RATIONALE OF THE STUDY

[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. These studies show that students find it difficult to learn Mathematics. 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. As per the review above 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

Comparative Analysis on Reaction of Students on Final Version of Computer Assisted Instruction for Teaching Arithmetic with Different Modes

B.   Objectives of the Study

- To study the effectiveness of the developed CAI in terms of Experimental Group A (only CAI) (Exp A) students' response to the reaction scale.
- To study the effectiveness of the developed CAI in terms of Experimental Group B (CAI with simultaneous Discussion) (Exp B) students' response to the reaction scale.
- To study the relative effectiveness of the developed CAI in terms of Experimental Group A (only CAI) students' response to the reaction scale and that of Experimental Group B(CAI with simultaneous Discussion).

C.   Hypotheses of the Study

H_0: *There is no significant difference between Experimental group A and Experimental group B towards effectiveness of the developed CAI.*

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 30 students and experimental group B consisted of 35 students. Experimental Group A studied through the developed CAI. Experimental Group B studied through the developed CAI along with simultaneous discussions. The total sample for the experiment consisted of 65 students. Students in both 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 in both the groups.

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) Reaction Scale developed by the Investigator and modified according to the advice given by the expert in English.

I. Plan and Procedure of 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: Students were taught in their respective methods for month till the completion of the selected arithmetic unit.

Step 4: Reaction scale was administered to the students and their response was collected and analysed.

IV. DATA ANALYSIS

Data were analyzed through the statistical technique χ^2.The Chi Square statistic compares the tallies or counts of categorical responses between two (or more) independent groups.

[19] Chi-square is a statistical test commonly used to compare observed data with data we would expect to obtain according to a specific hypothesis. Then we might want to know about the "goodness to fit" between the observed and expected. Were the deviations (differences between observed and expected) the result of chance, or were they due to other factors. How much deviation can occur before you, the investigator, must conclude that something other than chance is at work, causing the observed to differ from the expected? The chi-square test is always testing what scientists call the **null hypothesis**, which states that there is no significant difference between the expected and observed result.

Most common application for chi-squared is in comparing observed counts of particular cases to the expected counts.

We can calculate X^2:

$$X^2 = \frac{(x_1 - E_1)^2}{E_1} + \frac{(x_2 - E_2)^2}{E_2} + \cdots + \frac{(x_k - E_k)^2}{E_k}$$

$$= \sum_{i=1}^{k} \frac{(x_i - E_i)^2}{E_i}$$

Comparative Analysis of Reaction Scale

Table 1: Positive Polarity Statements are given Points as follows

Response	Strongly Agree	Agree	Not Decided	Disagree	Strongly Disagree
Points	5	4	3	2	1

Table 2: Negative polarity statements are given points as follows

Response	Strongly Disagree	Disagree	Not Decided	Agree	Strongly Agree
Points	5	4	3	2	1

Statement 1: I enjoyed this class compared to normal classroom teaching because this method is more interesting to understand than lectures.

Table 3: Response for Statement 1

Points	Response of Exp B	Response of Exp A
5	4	7
4	13	11
3	2	9
2	12	1
1	3	1

Chi-square statistics = 15.4
degrees of freedom = 4
probability of chance = 0.004

Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is more than the table value therefore, Null hypothesis is rejected. This revealed that there is significant difference observed between Experimental group A and Experimental B towards effectiveness of the developed CAI for the given statement.

38.24% students of Exp B 'agree' where as 37.93% students of the Exp A 'agree' with the statement I. More load is on 'agree' of the Exp B which implies they found CAI more effective than the Exp A.

Graph 1: Graphical Representation of analysis of statement 1
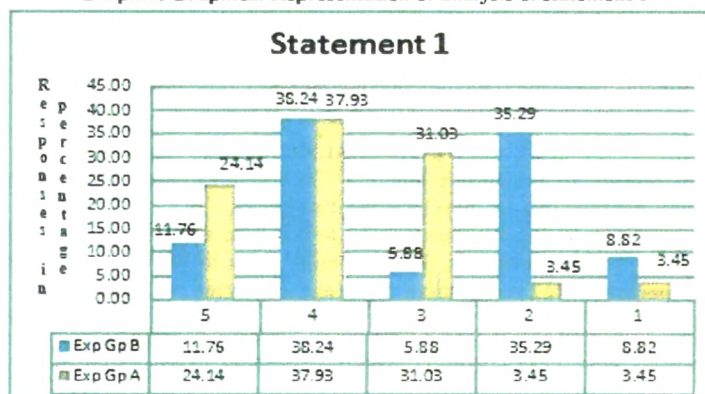
Statement 2: I like illustrations given in the slides, which actually made me learn the lesson.

Table 4: Response for Statement 2

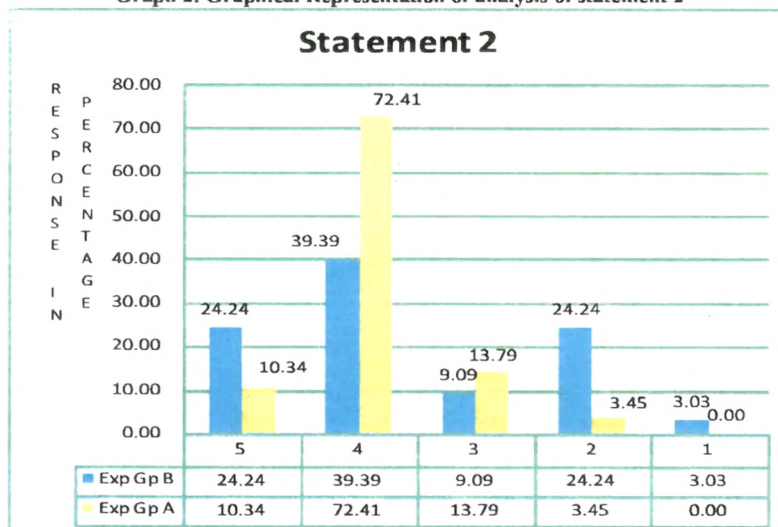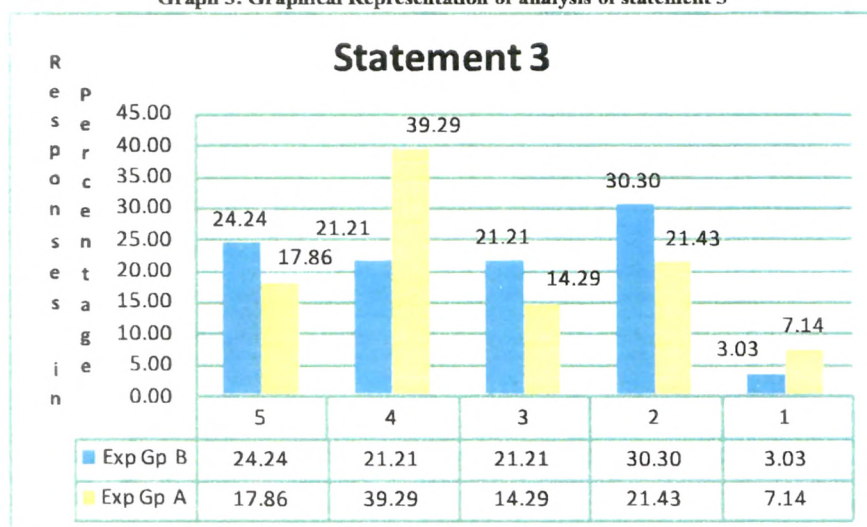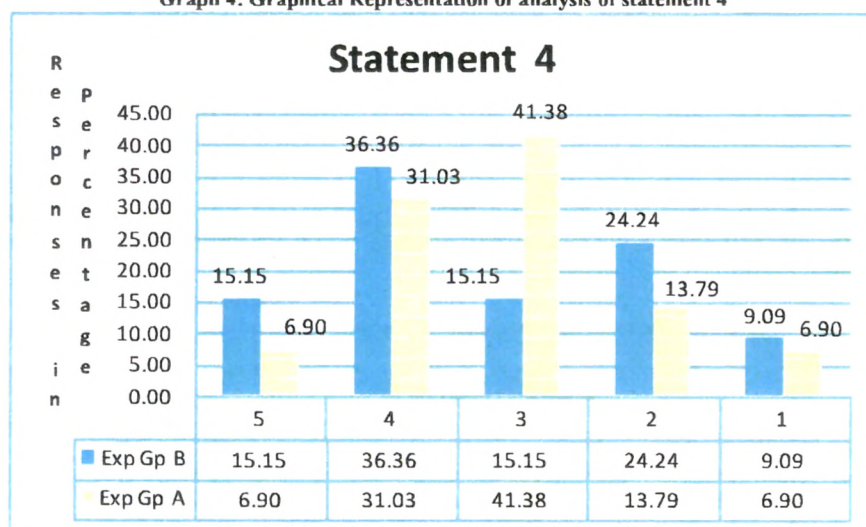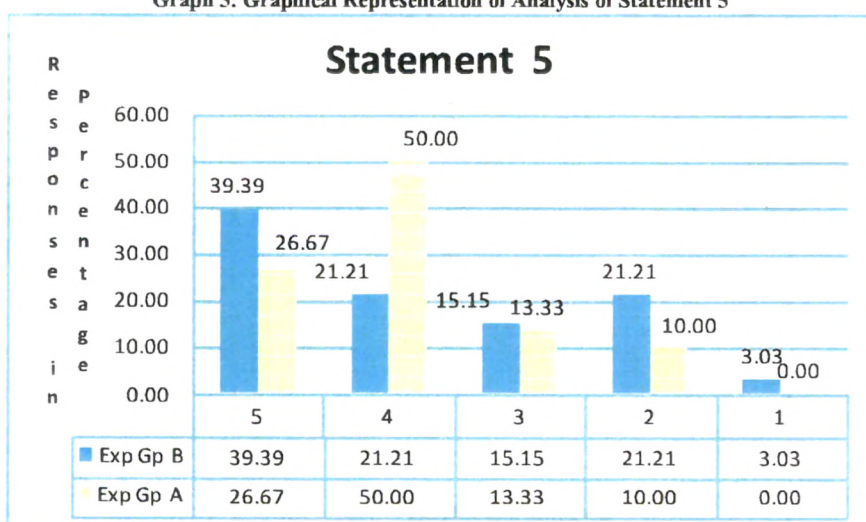| Points	Response of Exp B	Response of Exp A
5	8	3
4	13	21
3	3	4
2	8	1
1	1	0

Chi-Square statistics = 10.5
Degrees of freedom = 4
Probability of chance = 0.032
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is more than the table value therefore, Null hypothesis is rejected. This revealed that there *is significant difference* observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.
39.39% students' of Exp B *'agree'* where as 72.41% students' of the Exp A *'agree'* with the statement 2. More load is on *'agree'* of the Exp A which implies that they found CAI more effective than the Exp B.

Graph 2: Graphical Representation of analysis of statement 2

Statement 3: Illustrations didn't help me to relate what we learned in mathematics to real life situation.

Table 5: Response for Statement 3

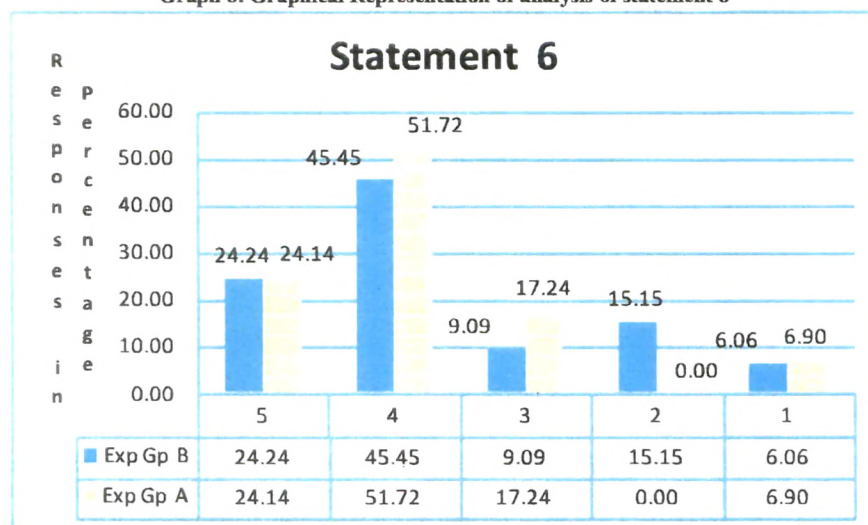| Points	Response of Exp B	Response of Exp A
5	8	5
4	7	11
3	7	4
2	10	6
1	1	2

Chi-Square statistics= 3.35
Degrees of freedom = 4
Probability of chance = 0.502
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 3: Graphical Representation of analysis of statement 3

	5	4	3	2	1
Exp Gp B	24.24	21.21	21.21	30.30	3.03
Exp Gp A	17.86	39.29	14.29	21.43	7.14

Statement 4: CAI is effective way of presentation because there is little stress in learning situation.

Table 6: Response for Statement 4

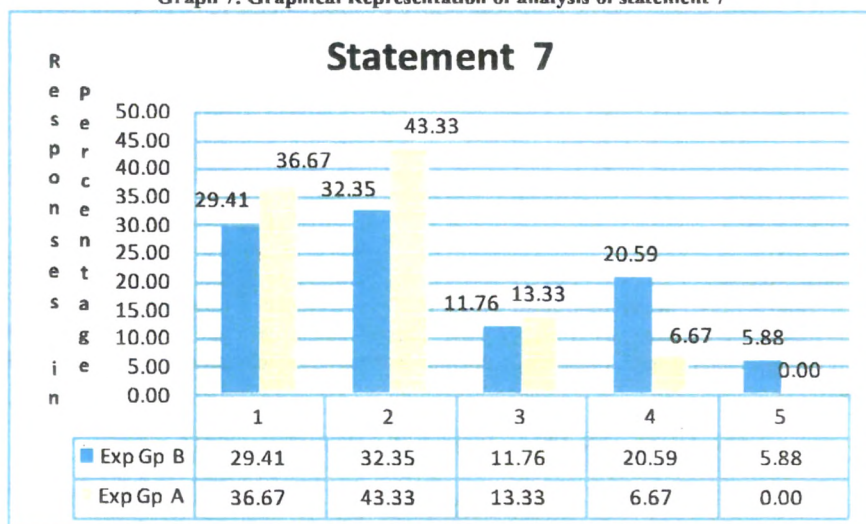| Points	Response of Exp B	Response of Exp A
5	5	2
4	12	9
3	5	12
2	8	4
1	3	2

Chi-Square statistics = 5.90
Degrees of freedom = 4
Probability of chance = 0.207
Table value of Chi Square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 4: Graphical Representation of analysis of statement 4

	5	4	3	2	1
Exp Gp B	15.15	36.36	15.15	24.24	9.09
Exp Gp A	6.90	31.03	41.38	13.79	6.90

Statement 5: I can learn with my own speed.

Table 7: Response for statement 5

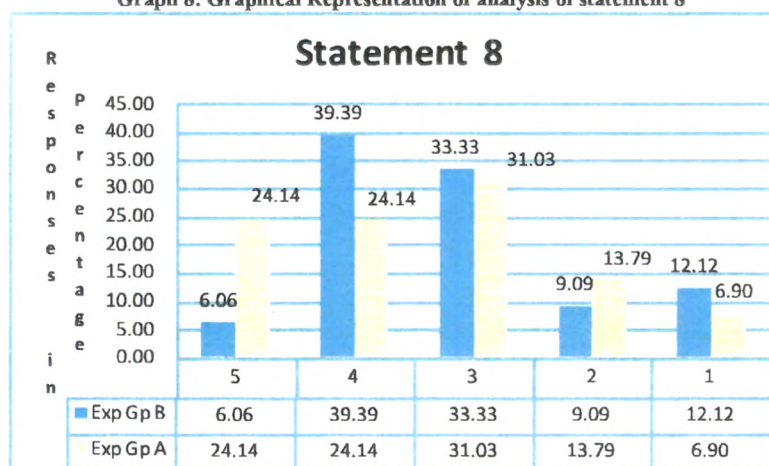| Points	Response of Exp B	Response of Exp A
5	13	8
4	7	15
3	5	4
2	7	3
1	1	0

Chi-Square statistics= 6.68

Degrees of freedom = 4

Probability of chance = 0.154

Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental groupB towards effectiveness of the developed CAI for the given statement.

Graph 5: Graphical Representation of Analysis of Statement 5

	5	4	3	2	1
Exp Gp B	39.39	21.21	15.15	21.21	3.03
Exp Gp A	26.67	50.00	13.33	10.00	0.00

Statement 6: I can immediately test myself because there is lot of practice exercise.

Table 8: Response for statement 6

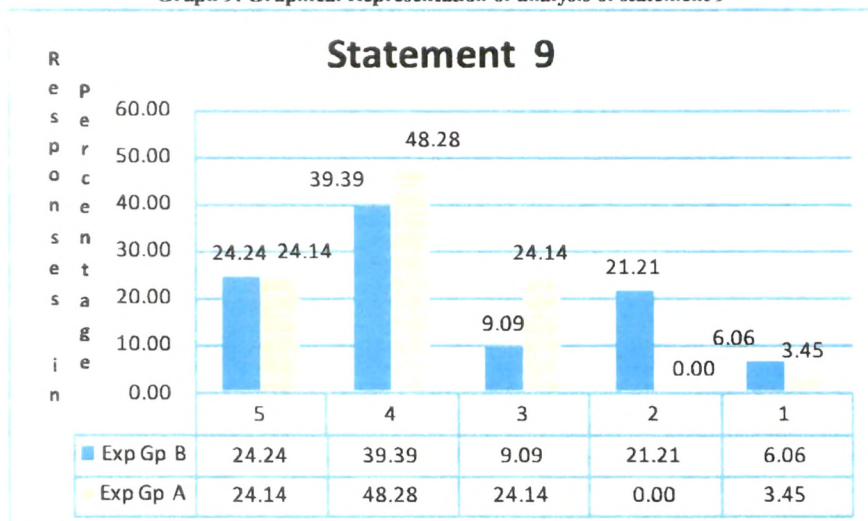| Points	Response of Exp B	Response of Exp A
5	8	7
4	15	15
3	3	5
2	5	0
1	2	2

Chi-Square statistics= 5.33
Degrees of freedom = 3
Probability of chance = 0.255
Table value of Chi Square at 3df at .05 significance level is 7.815. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental B towards effectiveness of the developed CAI for the given statement.

Graph 6: Graphical Representation of analysis of statement 6

	5	4	3	2	1
Exp Gp B	24.24	45.45	9.09	15.15	6.06
Exp Gp A	24.14	51.72	17.24	0.00	6.90

Statement 7: This method is having more freedom to learn

Table 9: Response for statement 7

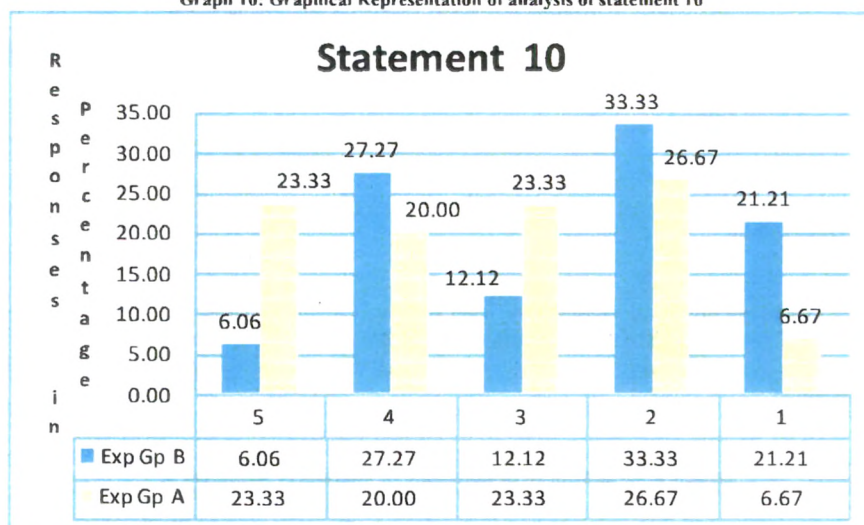| Points	Response of Exp B	Response of Exp A
5	10	11
4	11	13
3	4	4
2	7	2
1	2	0

Chi-Square statistics = 4.76
Degrees of freedom = 4
Probability of chance= 0.313

Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 7: Graphical Representation of analysis of statement 7

	1	2	3	4	5
Exp Gp B	29.41	32.35	11.76	20.59	5.88
Exp Gp A	36.67	43.33	13.33	6.67	0.00

Statement 8: CAI didn't focus on more freedom situation.

Table 10: Response for statement 8

Points	Response of Exp B	Response of Exp A
5	2	7
4	13	7
3	11	9
2	3	4
1	4	2

Chi-Square statistics = 5.35
Degrees of freedom = 4
Probability of chance = 0.253
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 8: Graphical Representation of analysis of statement 8

	5	4	3	2	1
Exp Gp B	6.06	39.39	33.33	9.09	12.12
Exp Gp A	24.14	24.14	31.03	13.79	6.90

Statement 9: Learning mathematics is fun in this CAI method.

Table 11: Response for statement 9

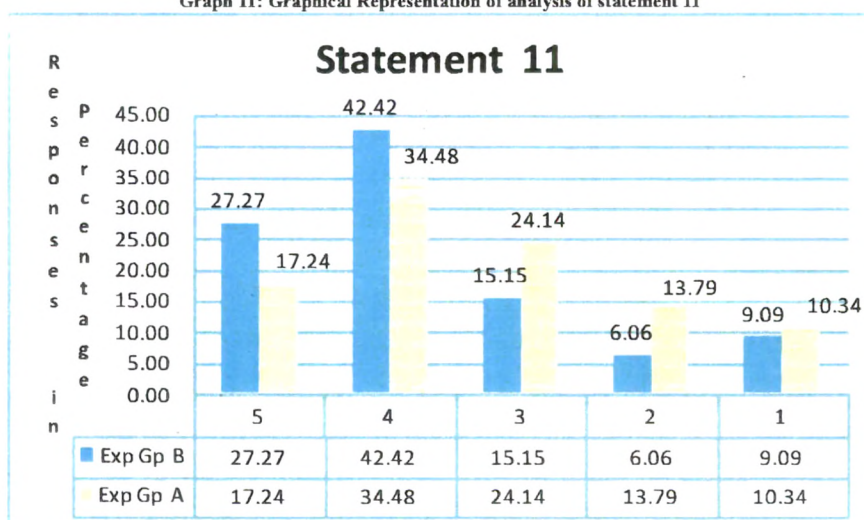| Points	Response of Exp B	Response of Exp A
5	8	7
4	13	14
3	3	7
2	7	0
1	2	1

Chi-Square statistics = 8.82
Degrees of freedom = 4
probability of chance = 0.066
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 9: Graphical Representation of analysis of statement 9

Statement 9

	5	4	3	2	1
Exp Gp B	24.24	39.39	9.09	21.21	6.06
Exp Gp A	24.14	48.28	24.14	0.00	3.45

Statement 10: This method is not good in learning mathematics because my doubts are not cleared.

Table 12: Response for statement 10

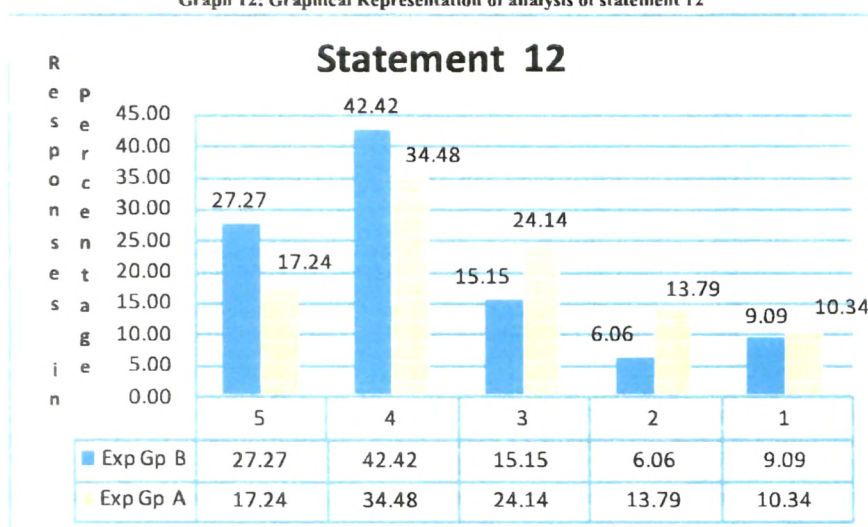| Points	Response of Exp B	Response of Exp A
5	2	7
4	9	6
3	4	7
2	11	8
1	7	2

Chi-Square statistics = 7.32
Degrees of freedom = 4
Probability of chance = 0.120
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 10: Graphical Representation of analysis of statement 10

Statement 10

	5	4	3	2	1
Exp Gp B	6.06	27.27	12.12	33.33	21.21
Exp Gp A	23.33	20.00	23.33	26.67	6.67

Statement 11: In CAI I can teach myself (self-study) without the help of others.

Table 13: Response for statement 11

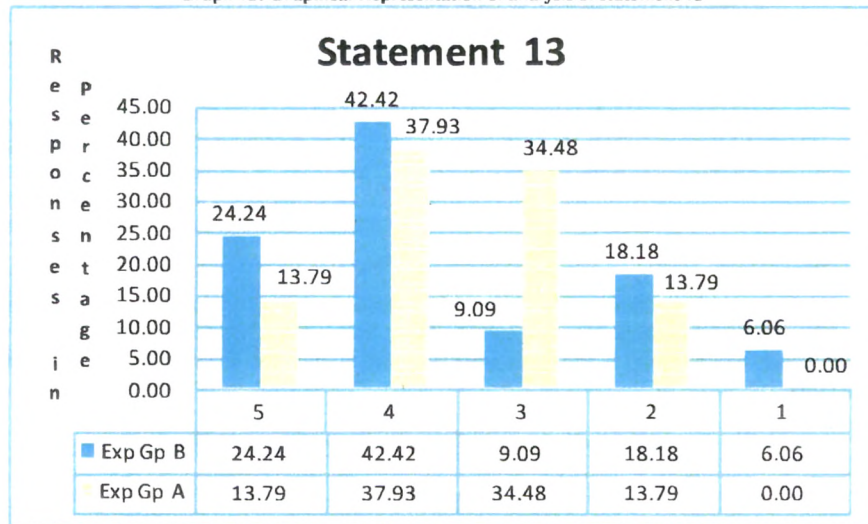| Points	Response of Exp B	Response of Exp A
5	9	5
4	14	10
3	5	7
2	2	4
1	3	3

Chi-Square statistics = 2.56
degrees of freedom = 4
probability of chance = 0.634
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 11: Graphical Representation of analysis of statement 11

Statement 11

	5	4	3	2	1
Exp Gp B	27.27	42.42	15.15	6.06	9.09
Exp Gp A	17.24	34.48	24.14	13.79	10.34

Statement 12: Matter presented in CAI is not very clear.

Table 14: Response for statement 12

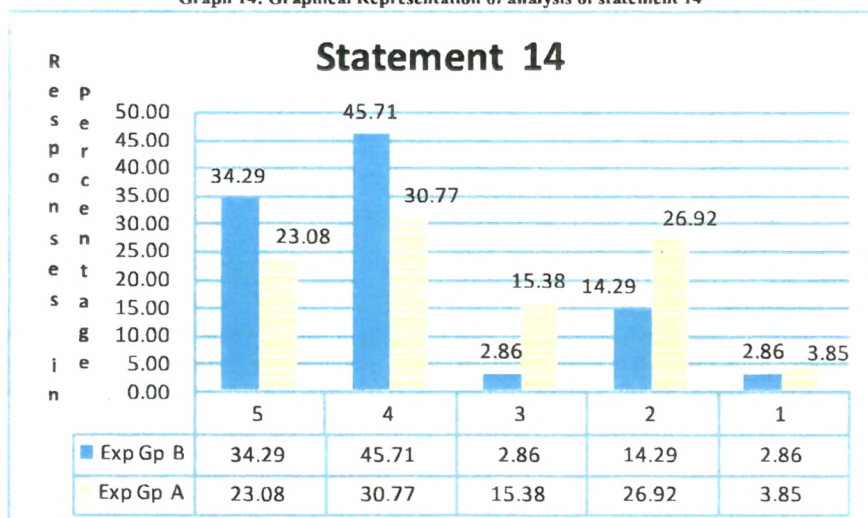| Points	Response of Exp B	Response of Exp A
5	6	3
4	11	11
3	7	9
2	7	6
1	2	1

Chi-Square statistics= 1.52
Degrees of freedom = 4
Probability of chance = 0.823
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 12: Graphical Representation of analysis of statement 12

Statement 12

	5	4	3	2	1
Exp Gp B	27.27	42.42	15.15	6.06	9.09
Exp Gp A	17.24	34.48	24.14	13.79	10.34

Statement 13: CAI is easy to understand.

Table 15: Response for statement 13

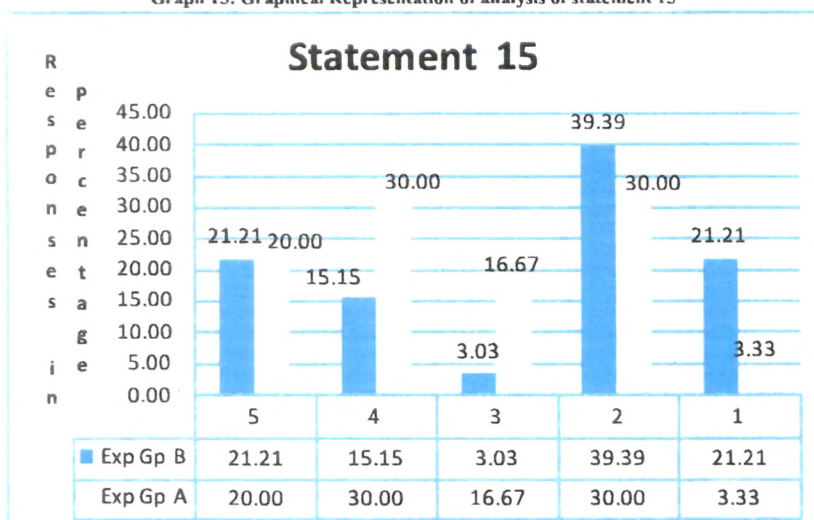| Points	Response of Exp B	Response of Exp A
5	8	4
4	14	11
3	3	10
2	6	4
1	2	0

Chi-Square statistics = 7.64
Degrees of freedom = 4
Probability of chance= 0.106
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental B towards effectiveness of the developed CAI for the given statement.

Graph 13: Graphical Representation of analysis of statement 13

Statement 13

	5	4	3	2	1
Exp Gp B	24.24	42.42	9.09	18.18	6.06
Exp Gp A	13.79	37.93	34.48	13.79	0.00

Statement 14: Animations are distracting in understanding the concept.

Table 16: Responses for statement 14

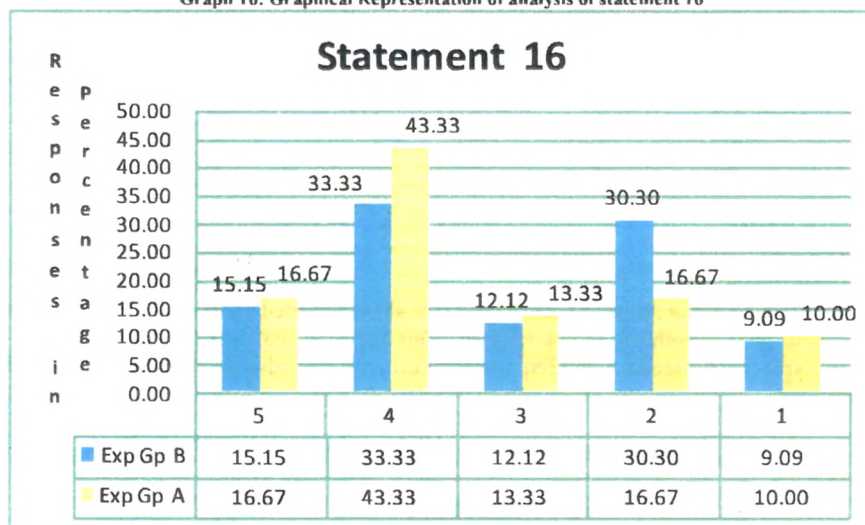| Points	Response of Exp B	Response of Exp A
5	12	6
4	16	8
3	1	4
2	5	7
1	1	1

Chi-Square statistics = 5.59
Degrees of freedom = 4
Probability of chance = 0.232
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 14: Graphical Representation of analysis of statement 14

Statement 14

	5	4	3	2	1
Exp Gp B	34.29	45.71	2.86	14.29	2.86
Exp Gp A	23.08	30.77	15.38	26.92	3.85

Statement 15: CAI took more time to understand the concept than usual classroom teaching.

Table 17: Responses for statement 15

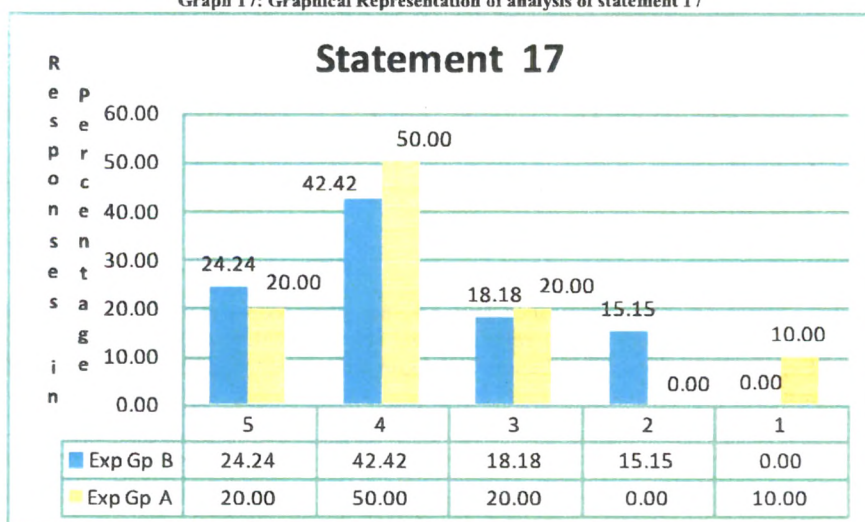| Points	Response of Exp B	Response of Exp A
5	7	6
4	5	9
3	1	5
2	13	9
1	7	1

Chi-Square statistics = 8.99
Degrees of freedom = 4
Probability of chance = 0.0610
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 15: Graphical Representation of analysis of statement 15

	5	4	3	2	1
Exp Gp B	21.21	15.15	3.03	39.39	21.21
Exp Gp A	20.00	30.00	16.67	30.00	3.33

Statement 16: Illustrations given in CAI are enough to understand the concept clearly.

Table 18: Responses for statement 16

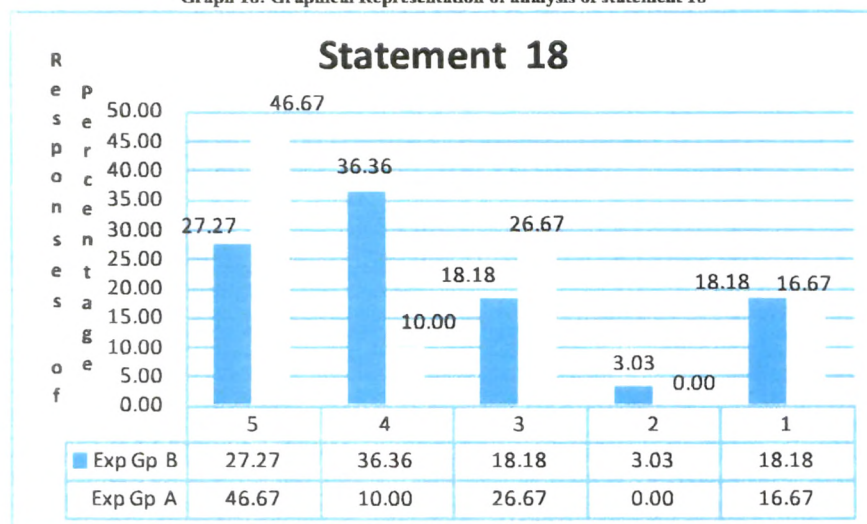| Points	Response of Exp B	Response of Exp A
5	5	5
4	11	13
3	4	4
2	10	5
1	3	3

Chi-Square statistics= 1.69
Degrees of freedom = 4
Probability of chance = 0.792
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 16: Graphical Representation of analysis of statement 16

Statement 16

	5	4	3	2	1
Exp Gp B	15.15	33.33	12.12	30.30	9.09
Exp Gp A	16.67	43.33	13.33	16.67	10.00

Statement 17: Matter presented in CAI was logically arranged.

Table 19: Responses for statement 17

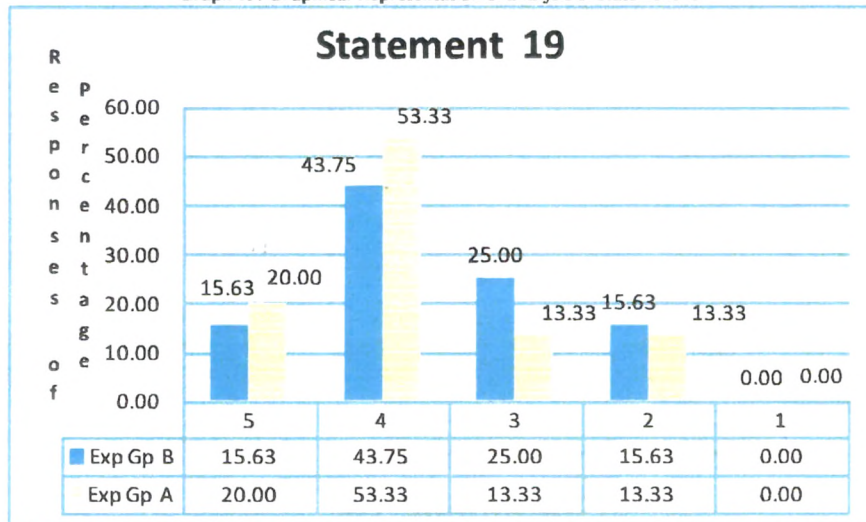| Points	Response of Exp B	Response of Exp A
5	8	6
4	14	15
3	6	6
2	5	0
1	0	3

Chi-Square statistics = 8.20
Degrees of freedom = 4
Probability of chance= 0.085
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 17: Graphical Representation of analysis of statement 17

Statement 17

	5	4	3	2	1
Exp Gp B	24.24	42.42	18.18	15.15	0.00
Exp Gp A	20.00	50.00	20.00	0.00	10.00

Statement 18: Learning through CAI was waste of time.

Table 20: Responses for statement 18

Points	Response of Exp B	Response of Exp A
5	9	14
4	12	3
3	6	8
2	1	0
1	6	5

Chi-Square = 7.64
Degrees of freedom = 4
Probability = 0.106
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no *significant difference* observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 18: Graphical Representation of analysis of statement 18

	5	4	3	2	1
Exp Gp B	27.27	36.36	18.18	3.03	18.18
Exp Gp A	46.67	10.00	26.67	0.00	16.67

Statement 19: Illustrations given in CAI are related to day today life experiences.

Table 21: Responses for statement 19

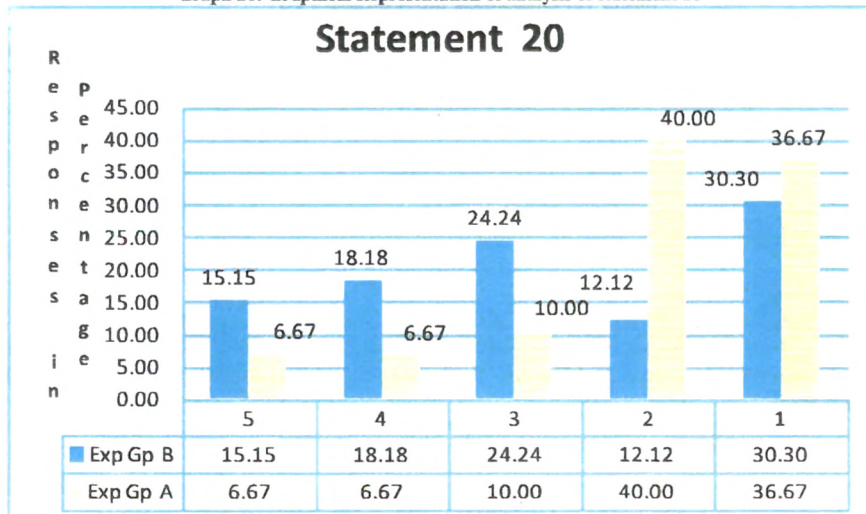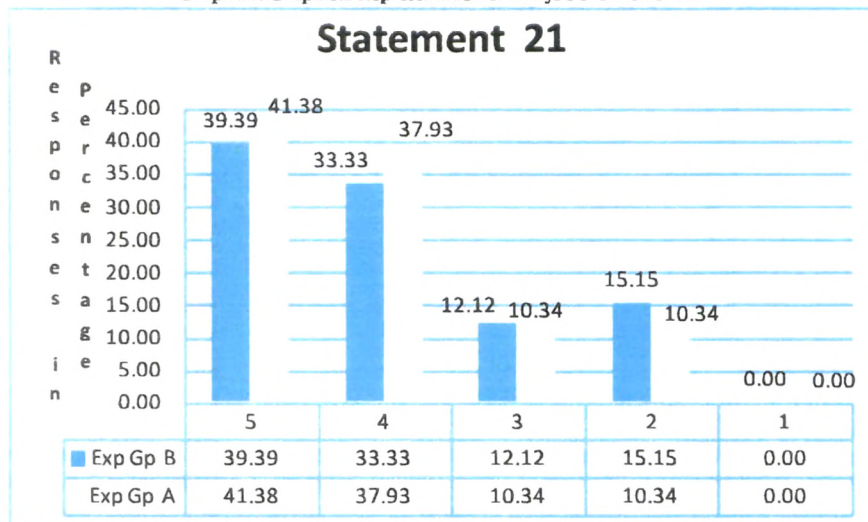| Points	Response of Exp B	Response of Exp A
5	5	6
4	14	16
3	8	4
2	5	4
1	0	0

Chi-Square statistics = 1.61
Degrees of freedom = 3
Probability of chance = 0.658
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 19: Graphical Representation of analysis of statement 19

Statement 19

	5	4	3	2	1
Exp Gp B	15.63	43.75	25.00	15.63	0.00
Exp Gp A	20.00	53.33	13.33	13.33	0.00

Statement 20: Classroom teaching is more enjoyable.

Table 22: Responses for statement 20

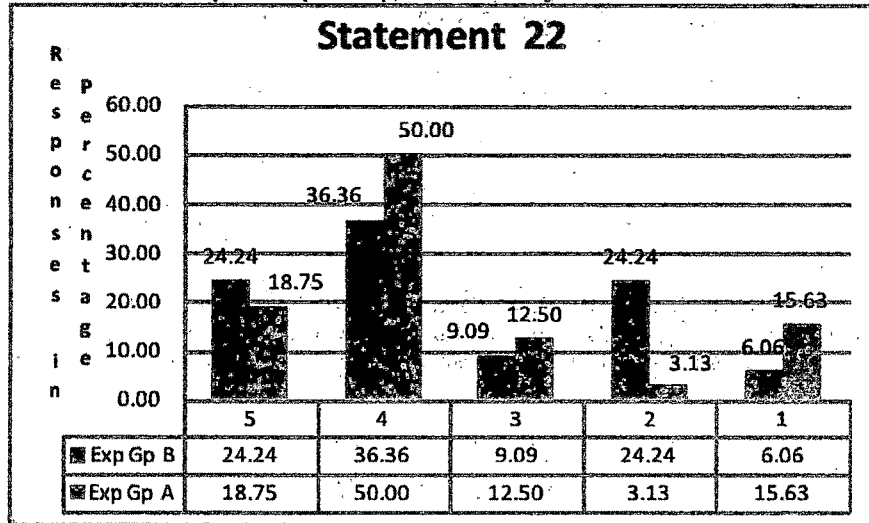| Points	Response of Exp B	Response of Exp A
5	5	2
4	6	2
3	8	3
2	4	12
1	10	11

Chi-Square statistics= 9.48
Degrees of freedom = 4
Probability of chance= 0.050
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 20: Graphical Representation of analysis of statement 20

Statement 20

	5	4	3	2	1
Exp Gp B	15.15	18.18	24.24	12.12	30.30
Exp Gp A	6.67	6.67	10.00	40.00	36.67

Statement 21: The language used in CAI is easy and simple to understand.

Table 23: Responses for statement 21

Points	Response of Exp B	Response of Exp A
5	13	12
4	11	11
3	4	3
2	5	3
1	0	0

Chi-Square = 0.427
Degrees of freedom = 3
Probability = 0.935
Table value of Chi Square at 3df at .05 significance level is 7.815. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 21: Graphical Representation of analysis of statement 21

	5	4	3	2	1
Exp Gp B	39.39	33.33	12.12	15.15	0.00
Exp Gp A	41.38	37.93	10.34	10.34	0.00

Statement 22: The exercises given in each chapter is adequate.

Table 24: Responses for statement 22

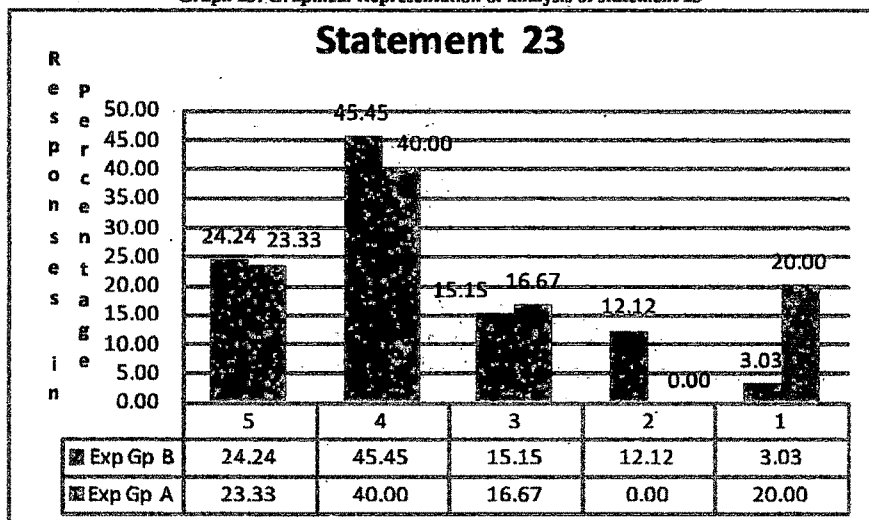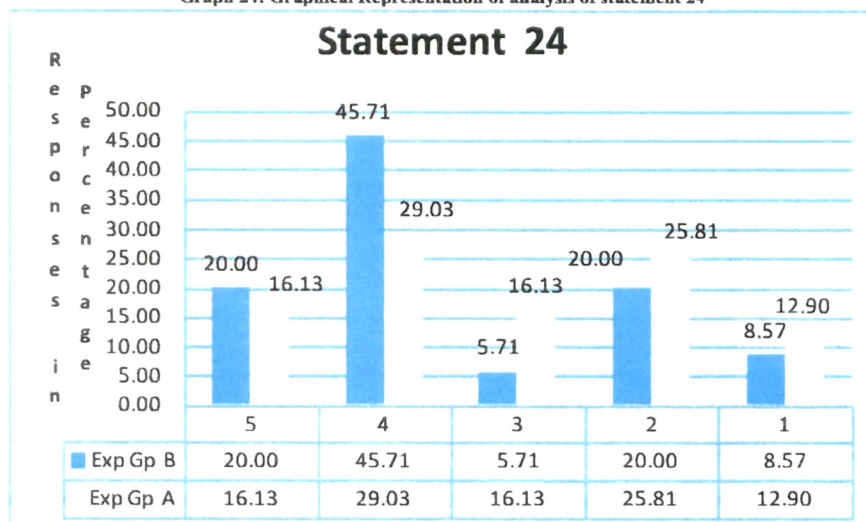| Points	Response of Exp B	Response of Exp A
5	8	6
4	12	16
3	3	4
2	8	1
1	2	5

Chi-Square statistics= 7.72
Degrees of freedom = 4
Probability of chance = 0.103
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 22: Graphical Representation of analysis of statement 22

Statement 22

	5	4	3	2	1
Exp Gp B	24.24	36.36	9.09	24.24	6.06
Exp Gp A	18.75	50.00	12.50	3.13	15.63

Statement 23: CAI takes care of previous knowledge in the subject.

Table 25: Responses for statement 23

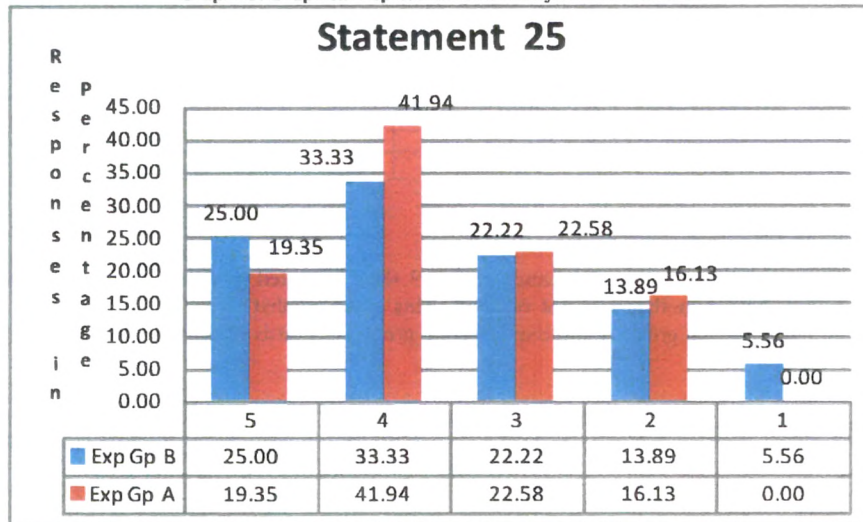| Points	Response of Exp B	Response of Exp A
5	8	7
4	15	12
3	5	5
2	4	0
1	1	6

Chi-Square statistics= 7.85
Degrees of freedom = 4
Probability of chance = 0.097
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 23: Graphical Representation of analysis of statement 23

Statement 23

	5	4	3	2	1
Exp Gp B	24.24	45.45	15.15	12.12	3.03
Exp Gp A	23.33	40.00	16.67	0.00	20.00

**Statement 24:** The solution to the problem is not easy to understand.

Table 26: Responses for statement 24

Points	Response of Exp B	Response of Exp A
5	7	5
4	16	9
3	2	5
2	7	8
1	3	4

Chi-Square statistics = 3.56
Degrees of freedom = 4
Probability of chance = 0.469
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 24: Graphical Representation of analysis of statement 24

Statement 24

	5	4	3	2	1
Exp Gp B	20.00	45.71	5.71	20.00	8.57
Exp Gp A	16.13	29.03	16.13	25.81	12.90

Statement 25: The exercises helped in understanding the chapter in depth.

Table 27: Responses for statement 25

Points	Response of Exp B	Response of Exp A
5	9	6
4	12	13
3	8	7
2	5	5
1	2	0

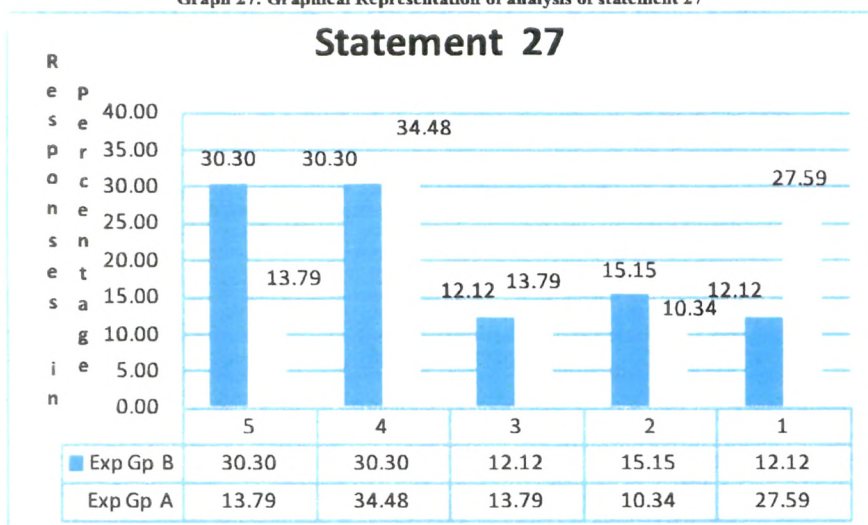Chi-Square statistics= 2.35
Degrees of freedom = 4
Probability of chance = 0.672
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 25: Graphical Representation of analysis of statement 25

Statement 25

	5	4	3	2	1
Exp Gp B	25.00	33.33	22.22	13.89	5.56
Exp Gp A	19.35	41.94	22.58	16.13	0.00

Statement 26: Solutions didn't help me whenever I was not able to solve the problem.

Table 28: Responses for statement 26

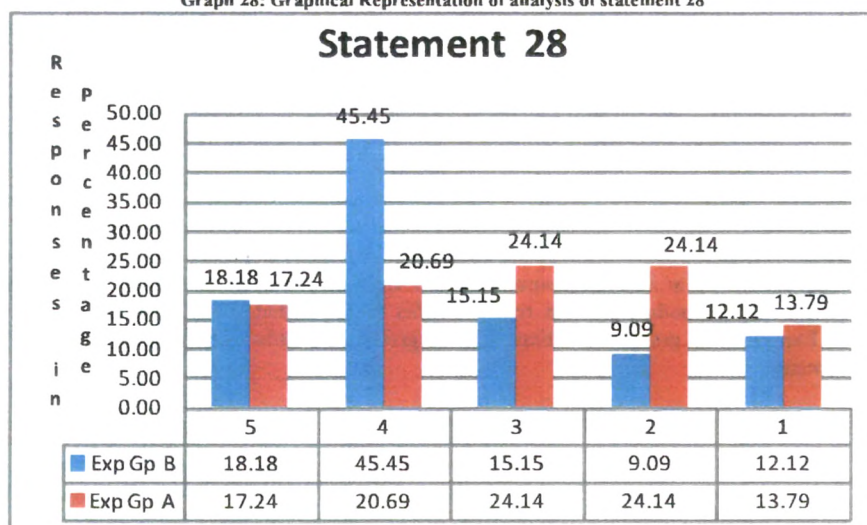| Points	Response of Exp B	Response of Exp A
5	13	9
4	6	2
3	2	9
2	10	7
1	4	2

Chi-Square statistics = 7.88
Degrees of freedom = 4
Probability of chance = 0.096

Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 26: Graphical Representation of analysis of statement 26

Statement 26

	5	4	3	2	1
Exp Gp B	37.14	17.14	5.71	28.57	11.43
Exp Gp A	31.03	6.90	31.03	24.14	6.90
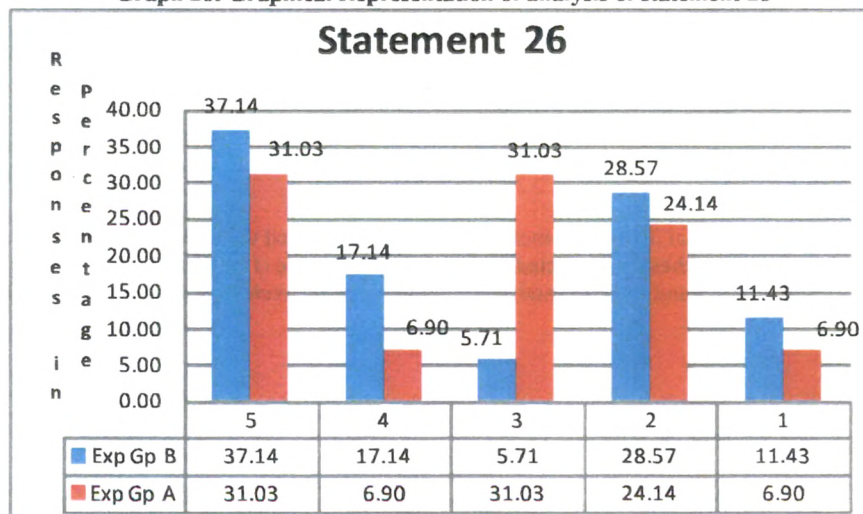
Statement 27: Break given in CAI helped me to refresh my mind.

Table 29: Responses for statement 27

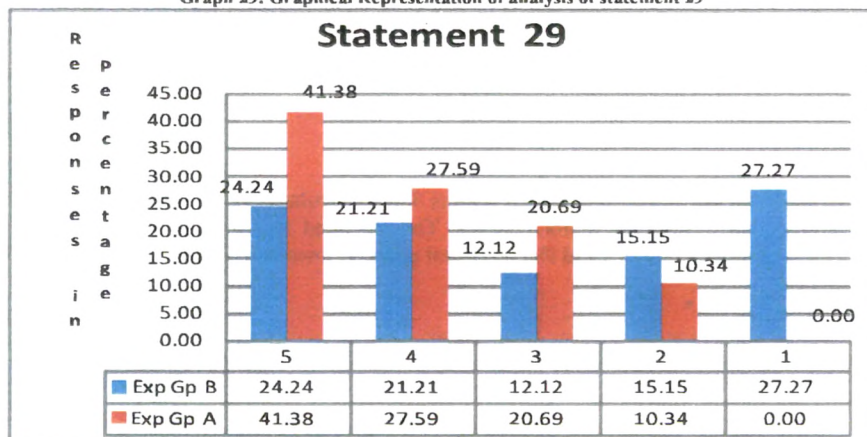| Points	Response of Exp B	Response of Exp A
1	10	4
2	10	10
3	4	4
4	5	3
5	4	8

Chi-Square of statistics = 4.16
Degrees of freedom = 4
Probability of chance= 0.384
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 27: Graphical Representation of analysis of statement 27

	5	4	3	2	1
Exp Gp B	30.30	30.30	12.12	15.15	12.12
Exp Gp A	13.79	34.48	13.79	10.34	27.59

Statement 28: I am feeling tired while going through the slide.

Table 30: Responses for statement 28

Points	Response of Exp B	Response of Exp A
5	6	5
4	15	6
3	5	7
2	3	7
1	4	4

hi-Square statistics = 5.65
Degrees of freedom = 4
Probability of chance = 0.227
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 28: Graphical Representation of analysis of statement 28

	5	4	3	2	1
■ Exp Gp B	18.18	45.45	15.15	9.09	12.12
■ Exp Gp A	17.24	20.69	24.14	24.14	13.79

Statement 29: Animation shown in CAI is appropriate to help me in understanding the concept.

Table 31: Responses for statement 29

Points	Response of Exp B	Response of Exp A
5	8	12
4	7	8
3	4	6
2	5	3
1	9	0

Chi-Square statistics = 10.6

Degrees of freedom = 4

Probability of chance = 0.032

Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is more than the table value therefore, Null hypothesis is rejected. This revealed that there is significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

24.24% students' of Exp B 'strongly *agree*' where as 41.38% students' of the Exp A ' strongly *agree*' with the statement 29. More load is on 'strongly *agree*' of the Exp A which implies that they found CAI more effective than the Exp B.

Graph 29: Graphical Representation of analysis of statement 29

	5	4	3	2	1
■ Exp Gp B	24.24	21.21	12.12	15.15	27.27
■ Exp Gp A	41.38	27.59	20.69	10.34	0.00

Statement 30: Topic is not introduced properly.

Table 32: Responses for statement 30

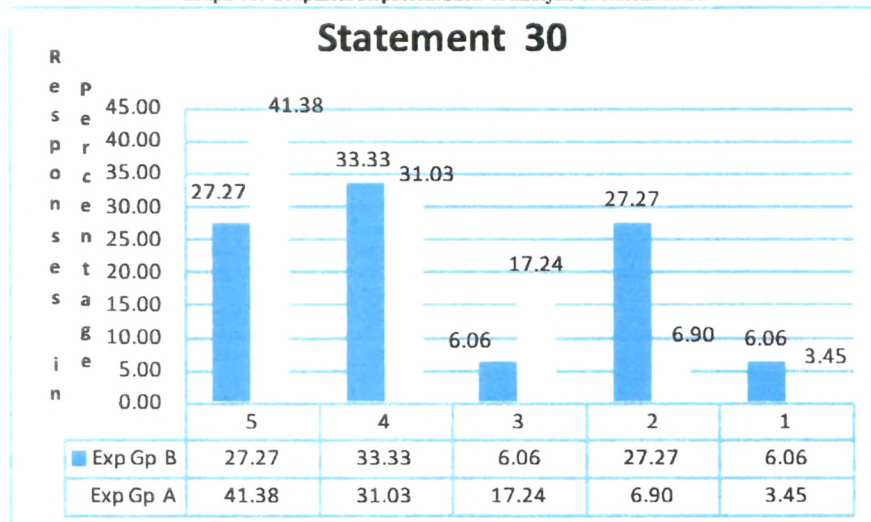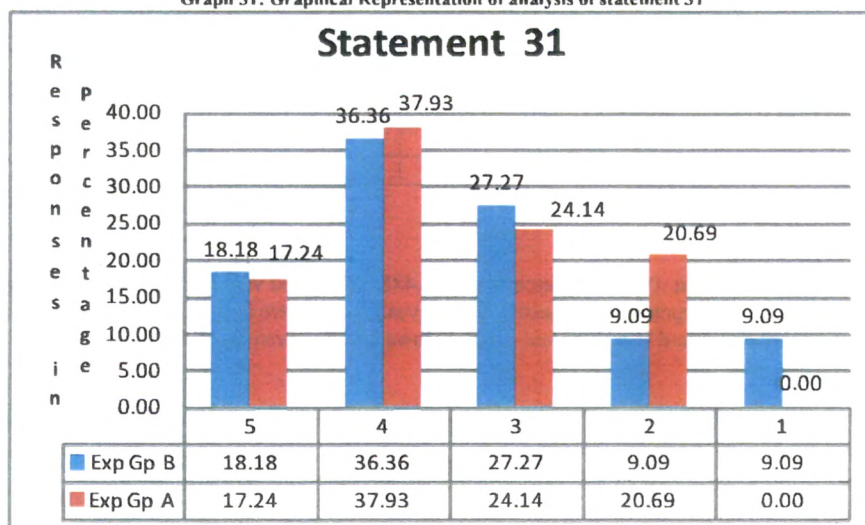| Points	Response of Exp B	Response of Exp A
5	9	12
4	11	9
3	2	5
2	9	2
1	2	1

Chi-Square statistics= 6.47

Degrees of freedom = 4

Probability of chance = 0.167

Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is more than the table value therefore, Null hypothesis is rejected. This revealed that there is significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 30: Graphical Representation of analysis of statement 30

	5	4	3	2	1
Exp Gp B	27.27	33.33	6.06	27.27	6.06
Exp Gp A	41.38	31.03	17.24	6.90	3.45

Statement 31: CAI does not take care of previous knowledge (percentage) needed to understand the present concept.

Table 33: Responses for statement 31

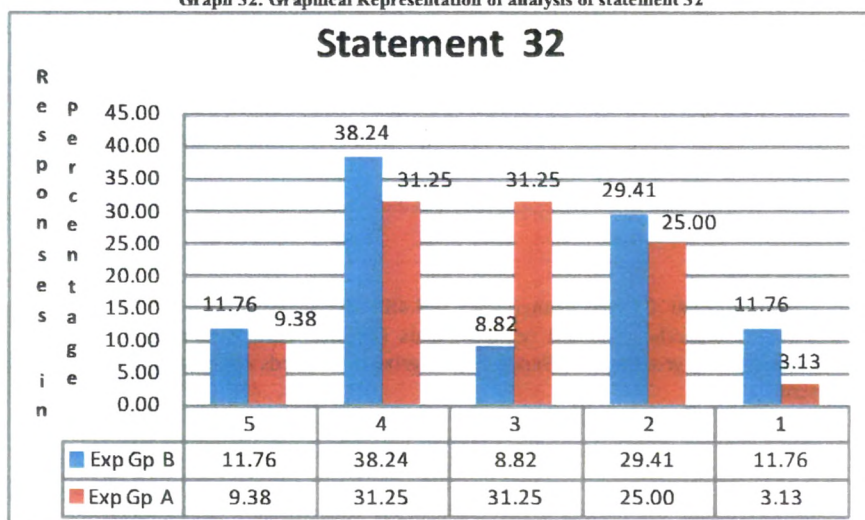| Points	Response of Exp B	Response of Exp A
5	6	5
4	12	11
3	9	7
2	3	6
1	3	0

Chi-Square statistics= 4.14

Degrees of freedom = 4

Probability of chance = 0.387

Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 31: Graphical Representation of analysis of statement 31

	5	4	3	2	1
Exp Gp B	18.18	36.36	27.27	9.09	9.09
Exp Gp A	17.24	37.93	24.14	20.69	0.00

Statement 32: Enough revision is not done in CAI after the topic simple interest.

Table 34: Responses for statement 32

Points	Response of Exp B	Response of Exp A
5	4	3
4	13	10
3	3	10
2	10	8
1	4	1

Chi-Square statistics= 6.27
Degrees of freedom = 4
Probability of chance = 0.180
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 32: Graphical Representation of analysis of statement 32

	5	4	3	2	1
Exp Gp B	11.76	38.24	8.82	29.41	11.76
Exp Gp A	9.38	31.25	31.25	25.00	3.13

Statement 33: Enough revision is not done in CAI after the topic compound interest.

Table 35: Responses for statement 33

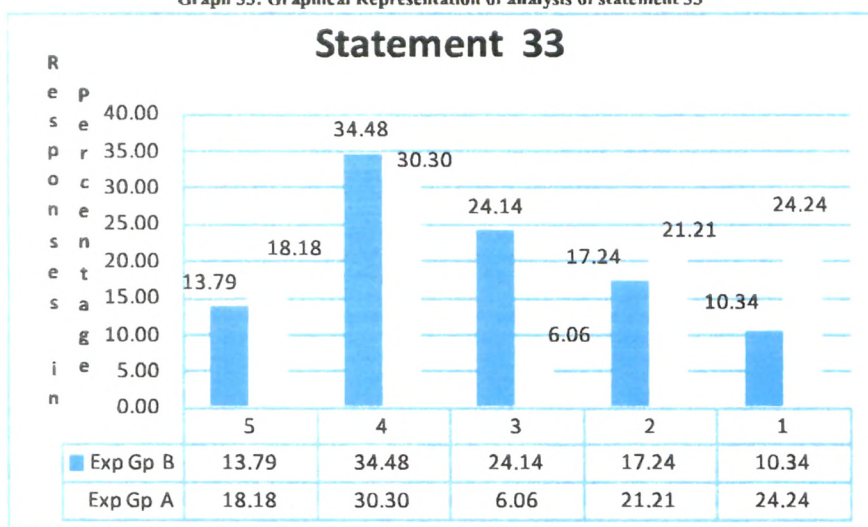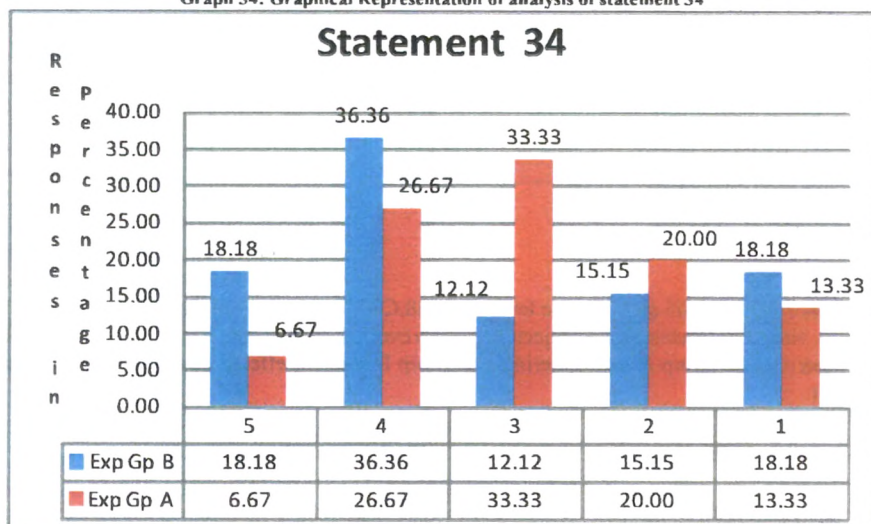| Points	Response of Exp B	Response of Exp A
5	4	6
4	10	10
3	7	2
2	5	7
1	3	8

Chi-Square statistics = 5.55
Degrees of freedom = 4
Probability of chance = 0.235
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 33: Graphical Representation of analysis of statement 33

	5	4	3	2	1
Exp Gp B	13.79	34.48	24.14	17.24	10.34
Exp Gp A	18.18	30.30	6.06	21.21	24.24

Statement 34: Enough revision is not done in CAI after the topic profit and loss.

Table 36: Responses for statement 34

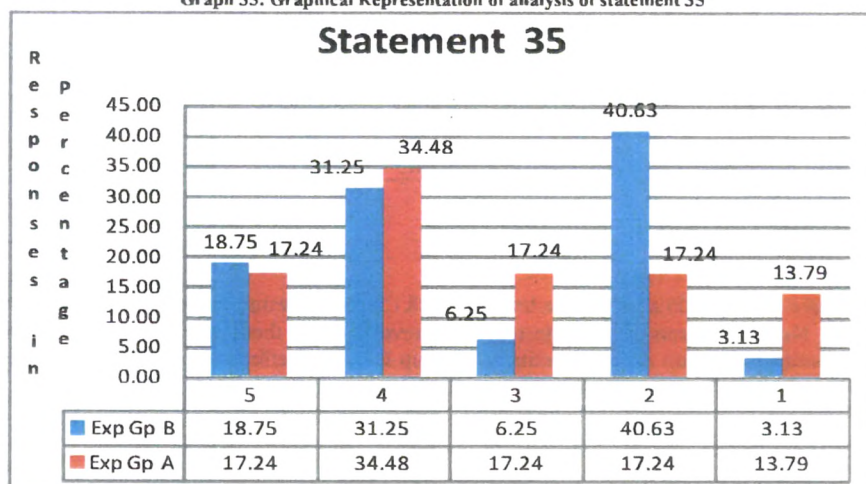| Points	Response of Exp B	Response of Exp A
5	6	2
4	12	8
3	4	10
2	5	6
1	6	4

Chi-Square statistics = 5.73
Degrees of freedom = 4
Probability of chance= 0.220
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 34: Graphical Representation of analysis of statement 34

Statement 34

	5	4	3	2	1
Exp Gp B	18.18	36.36	12.12	15.15	18.18
Exp Gp A	6.67	26.67	33.33	20.00	13.33

Statement 35: Remedial (re teaching the difficult concept which is not understood by you) teaching is not done.

Table 37: Responses for statement 35

Points	Response of Exp B	Response of Exp A
5	6	5
4	10	10
3	2	5
2	13	5
1	1	4

Chi-Square statistics = 6.60
Degrees of freedom = 4
Probability of chance = 0.159
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 35: Graphical Representation of analysis of statement 35

Statement 35

	5	4	3	2	1
Exp Gp B	18.75	31.25	6.25	40.63	3.13
Exp Gp A	17.24	34.48	17.24	17.24	13.79

Statement 36: I had to read the slide many times to understand what is being said as there was no clarity in understand.

Table 38: Responses for statement 36

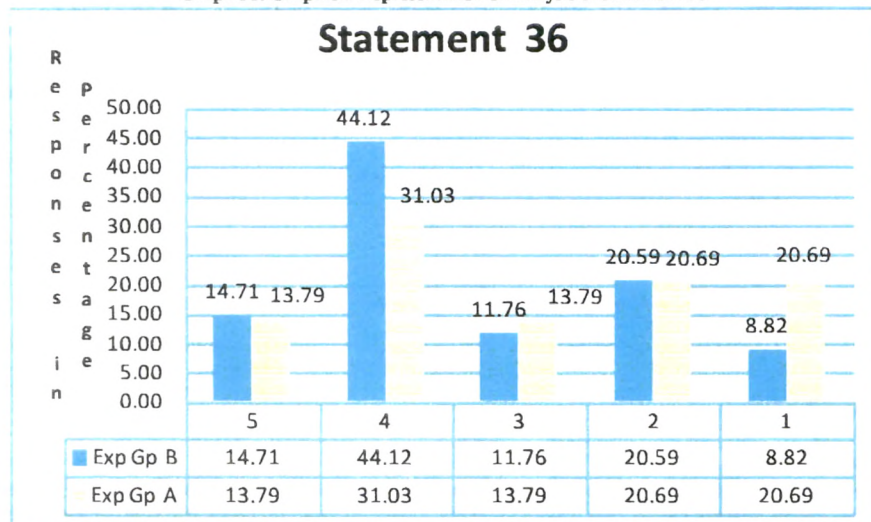| Points	Response of Exp B	Response of Exp A
5	5	4
4	15	9
3	4	4
2	7	6
1	3	6

Chi-Square statistics = 2.31
Degrees of freedom = 4
Probability of chance = 0.680
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 36: Graphical Representation of analysis of statement 36

Statement 36

	5	4	3	2	1
Exp Gp B	14.71	44.12	11.76	20.59	8.82
Exp Gp A	13.79	31.03	13.79	20.69	20.69

Statement 37: Number of questions at the end of the slides for the topic profit and loss is adequate for providing practice.

Table 39: Responses for statement 37

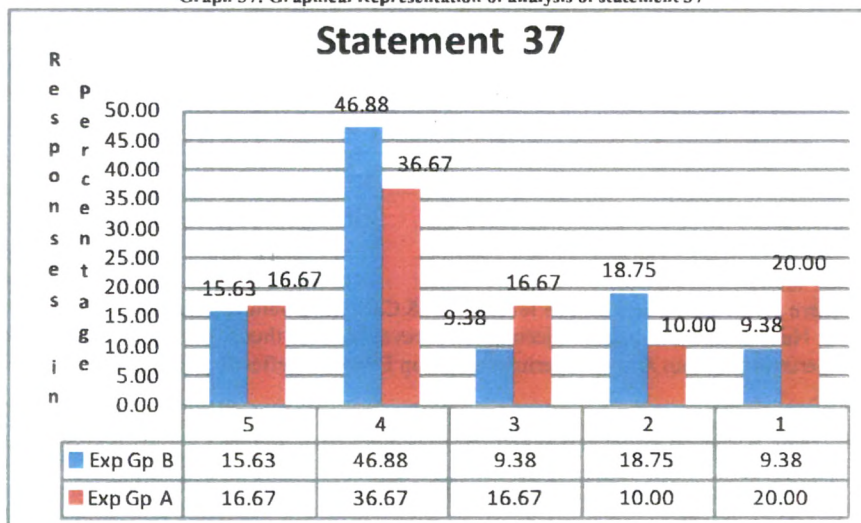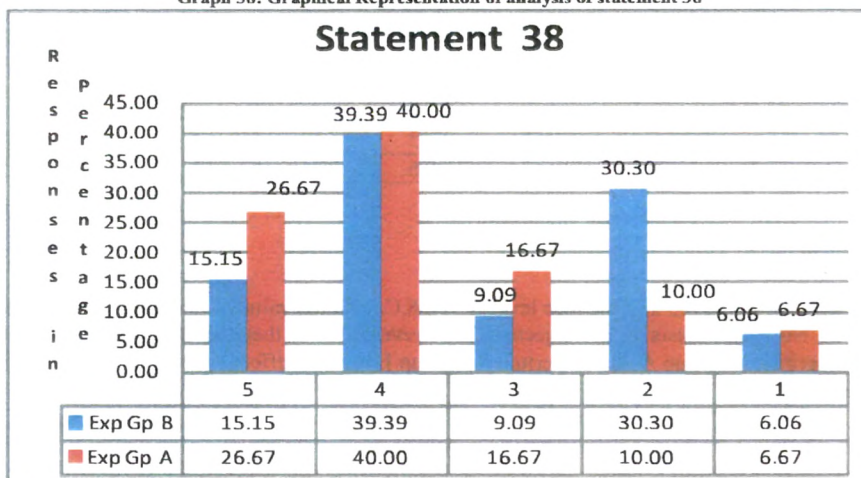| Points	Response of Exp B	Response of Exp A
5	5	5
4	15	11
3	3	5
2	6	3
1	3	6

Chi-Square = 3.05
Degrees of freedom = 4
Probability = 0.549
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 37: Graphical Representation of analysis of statement 37

	5	4	3	2	1
Exp Gp B	15.63	46.88	9.38	18.75	9.38
Exp Gp A	16.67	36.67	16.67	10.00	20.00

Statement 38: Number of questions at the end of the slides for the topic simple interest is adequate for providing practice.

Table 40: Responses for statement 38

Points	Response of Exp B	Response of Exp A
5	5	8
4	13	12
3	3	5
2	10	3
1	2	2

Chi-Square statistics = 4.87
Degrees of freedom = 4
Probability of chance = 0.301
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 38: Graphical Representation of analysis of statement 38

	5	4	3	2	1
Exp Gp B	15.15	39.39	9.09	30.30	6.06
Exp Gp A	26.67	40.00	16.67	10.00	6.67

Statement 39: Number of questions at the end of the slides for the topic compound interest is adequate for providing practice.

Table 41: Responses for statement 39

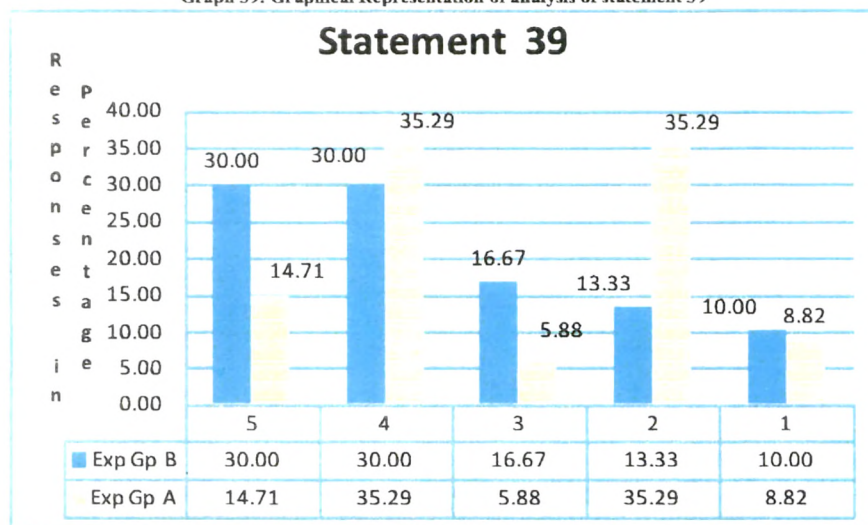| Points	Response of Exp B	Response of Exp A
5	9	5
4	9	12
3	5	2
2	4	12
1	3	3

Chi-Square statistics = 6.63
Degrees of freedom = 4
Probability of chance = 0.157
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 39: Graphical Representation of analysis of statement 39

	5	4	3	2	1
Exp Gp B	30.00	30.00	16.67	13.33	10.00
Exp Gp A	14.71	35.29	5.88	35.29	8.82

Statement 40: CAI is not enough in understanding the concept very clearly.

Table 42: Responses for statement 40

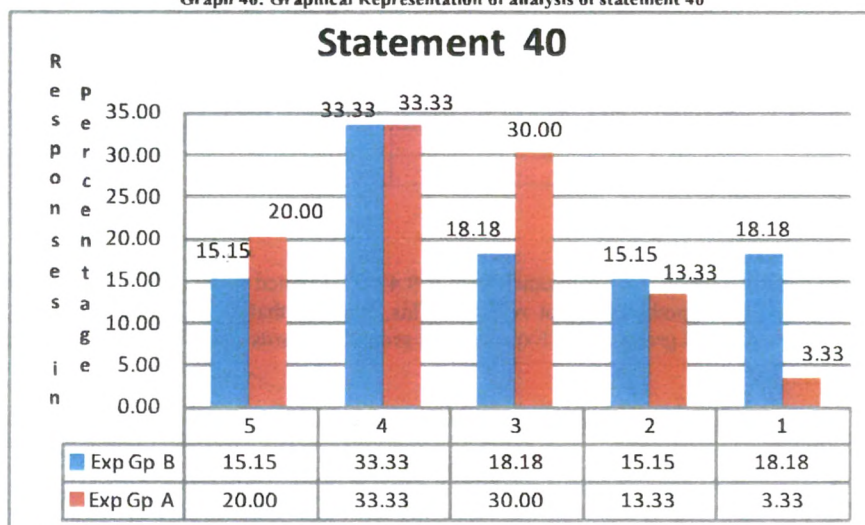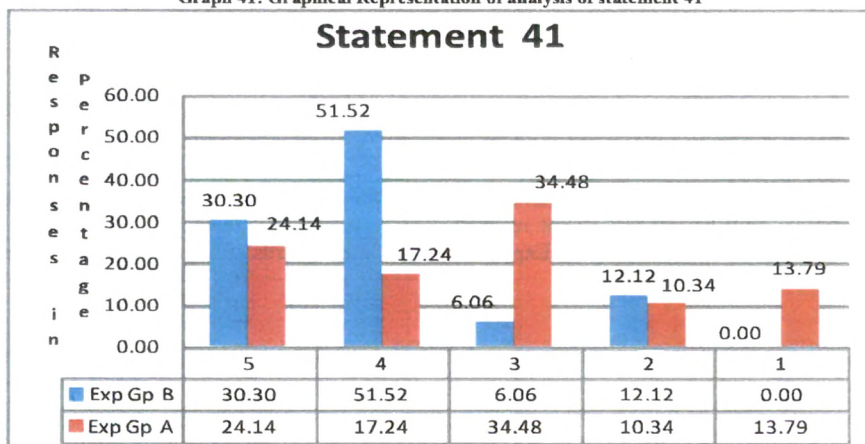| Points	Response of Exp B	Response of Exp A
5	5	6
4	11	10
3	6	9
2	5	4
1	6	1

Chi-Square statistics = 4.29
Degrees of freedom = 4
Probability of chance = 0.368
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 40: Graphical Representation of analysis of statement 40

Statement 40

	5	4	3	2	1
Exp Gp B	15.15	33.33	18.18	15.15	18.18
Exp Gp A	20.00	33.33	30.00	13.33	3.33

Statement 41: Independent learning is not possible through CAI.

Table 43: Responses for statement 41

Points	Response of Exp B	Response of Exp A
5	10	7
4	17	5
3	2	10
2	4	3
1	0	4

Chi-Square statistics = 16.4
Degrees of freedom = 4
Probability of chance = 0.003
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is more than the table value therefore, Null hypothesis is rejected. This revealed that there is significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

51.52% students of Exp B '*disagree*' where as 17.24% students of Exp A '*Disagree*' with the statement 41. More load is on '*disagree*' of the Exp B than Exp A.

Graph 41: Graphical Representation of analysis of statement 41

Statement 41

	5	4	3	2	1
Exp Gp B	30.30	51.52	6.06	12.12	0.00
Exp Gp A	24.14	17.24	34.48	10.34	13.79

Statement 42: Evaluation is done objectively (objective questions) so no partiality is involved in scoring.

Table 44: Responses for statement 42

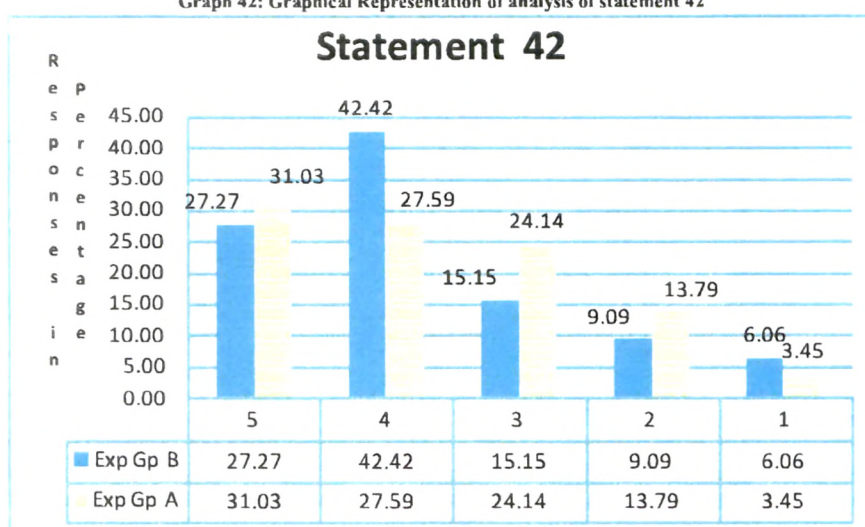| Points	Response of Exp B	Response of Exp A
5	9	9
4	14	8
3	5	7
2	3	4
1	2	1

Chi-Square statistics= 2.20
Degrees of freedom = 4
Probability of chance = 0.700
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 42: Graphical Representation of analysis of statement 42

	5	4	3	2	1
Exp Gp B	27.27	42.42	15.15	9.09	6.06
Exp Gp A	31.03	27.59	24.14	13.79	3.45

Statement 43: Evaluation done at the end of the topic "simple interest" is not suitable measure to know my understanding about that topic.

Table 45: Responses for statement 43

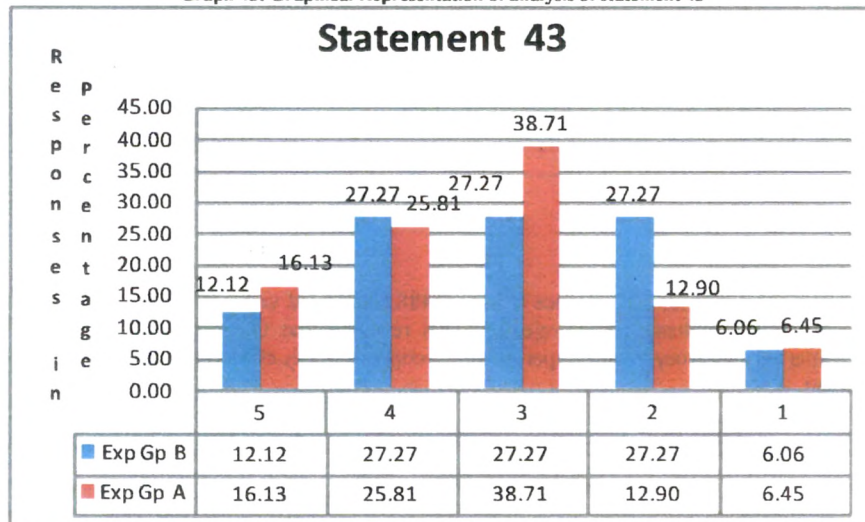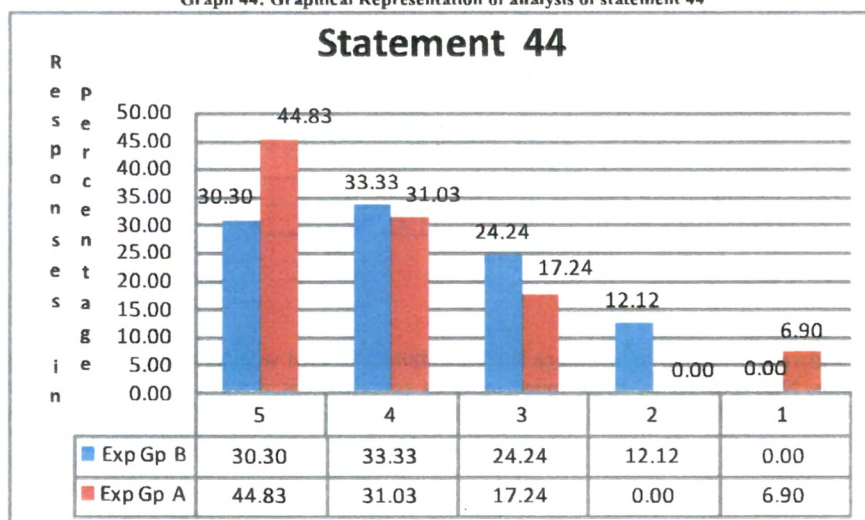| Points	Response of Exp B	Response of Exp A
5	4	5
4	9	8
3	9	12
2	9	4
1	2	2

Chi-Square statistics = 2.46
Degrees of freedom = 4
Probability of chance= 0.652
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 43: Graphical Representation of analysis of statement 43

Statement 43

	5	4	3	2	1
Exp Gp B	12.12	27.27	27.27	27.27	6.06
Exp Gp A	16.13	25.81	38.71	12.90	6.45

Statement 44: Instruction given in each slide of CAI is easy and clear to follow.

Table 46: Responses for statement 44

Points	Response of Exp B	Response of Exp A
5	10	13
4	11	9
3	8	5
2	4	0
1	0	2

Chi-square statistics = 7.05
Degree of freedom = 4
Probability of chance =.133
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 44: Graphical Representation of analysis of statement 44

Statement 44

	5	4	3	2	1
Exp Gp B	30.30	33.33	24.24	12.12	0.00
Exp Gp A	44.83	31.03	17.24	0.00	6.90

Statement 45: Evaluation done at the end of the topic profit and loss is not suitable measure to know my Understanding about that topic.

Table 47: Responses for statement 45

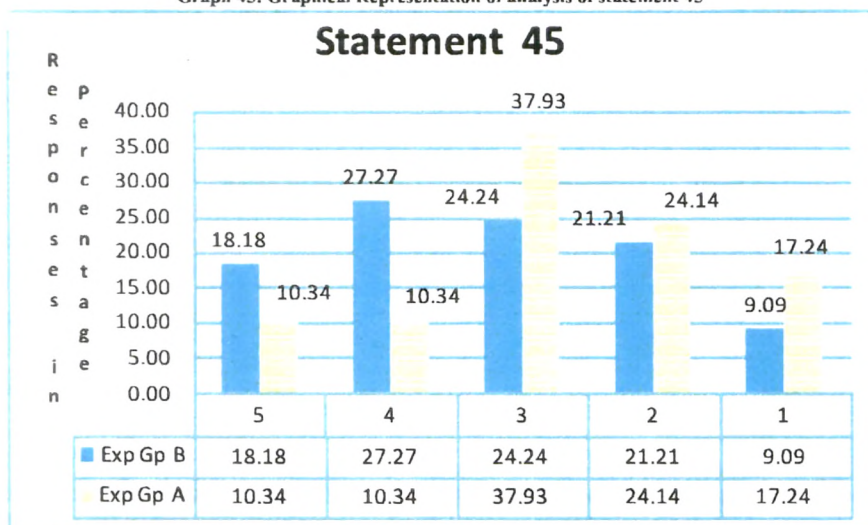| Points	Response of Exp B	Response of Exp A
5	6	3
4	9	3
3	8	11
2	7	7
1	3	5

Chi-square statistics = 4.74
Degree of freedom = 4
Probability of chance =.316
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 45: Graphical Representation of analysis of statement 45

	5	4	3	2	1
Exp Gp B	18.18	27.27	24.24	21.21	9.09
Exp Gp A	10.34	10.34	37.93	24.14	17.24

Statement 46: Interaction with mathematics teacher is not possible while using this CAI.

Table 48: Responses for statement 46

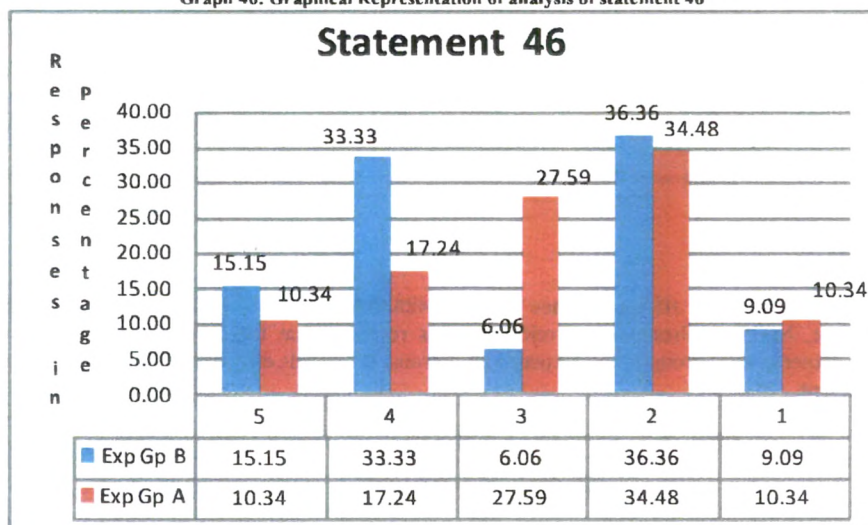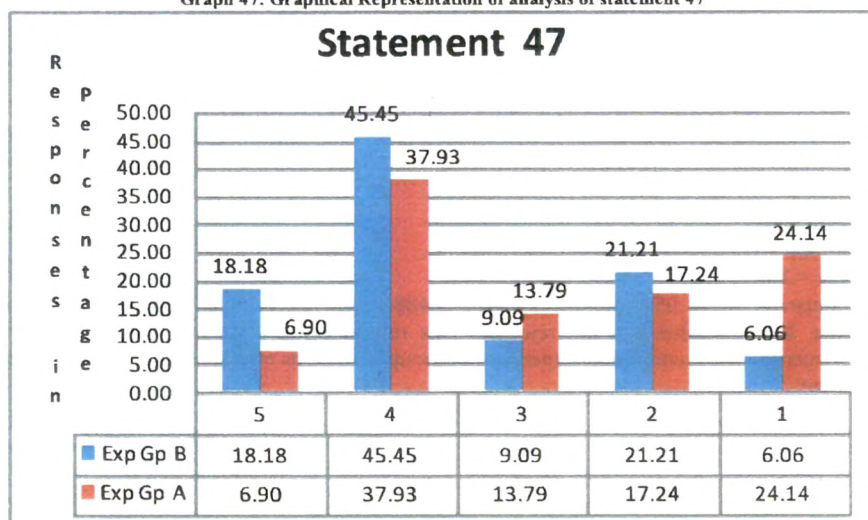| Points	Response of Exp B	Response of Exp A
5	5	3
4	11	5
3	2	8
2	12	10
1	3	3

Chi-square statistics = 6.30
Degree of freedom = 4
Probability of chance =.178
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 46: Graphical Representation of analysis of statement 46

Statement 46

	5	4	3	2	1
Exp Gp B	15.15	33.33	6.06	36.36	9.09
Exp Gp A	10.34	17.24	27.59	34.48	10.34

Statement 47: To get the correct answer I had to go back to the slide/s many times for topic simple interest.

Table 49: Responses for statement 47

Points	Response of Exp B	Response of Exp A
5	6	2
4	15	11
3	3	4
2	7	5
1	2	7

Chi-square statistics = 5.63
Degree of freedom = 4
Probability of chance = .228
Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 47: Graphical Representation of analysis of statement 47

Statement 47

	5	4	3	2	1
Exp Gp B	18.18	45.45	9.09	21.21	6.06
Exp Gp A	6.90	37.93	13.79	17.24	24.14

Statement 48: To get the correct answer I had to go back to the slide/s many times for topic Compound interest.

Table 50: Responses for statement 48

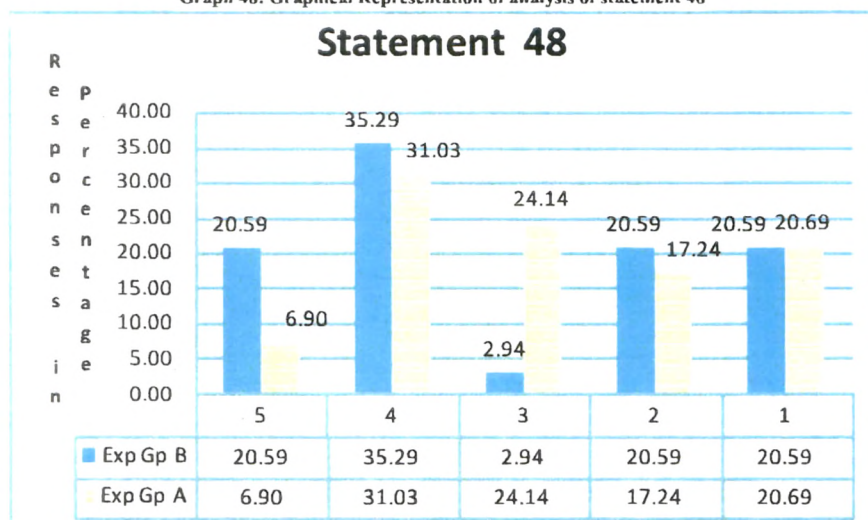| Points	Response of Exp B	Response of Exp A
5	7	2
4	12	9
3	1	7
2	7	5
1	7	6

Chi-square statistics = 7.77
Degree of freedom = 4
Probability of chance =.100
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 48: Graphical Representation of analysis of statement 48

	5	4	3	2	1
Exp Gp B	20.59	35.29	2.94	20.59	20.59
Exp Gp A	6.90	31.03	24.14	17.24	20.69

Statement 49: To get the correct answer I had to go back to the slide/s many times for topic profit and loss.

Table 51: Responses for statement 49

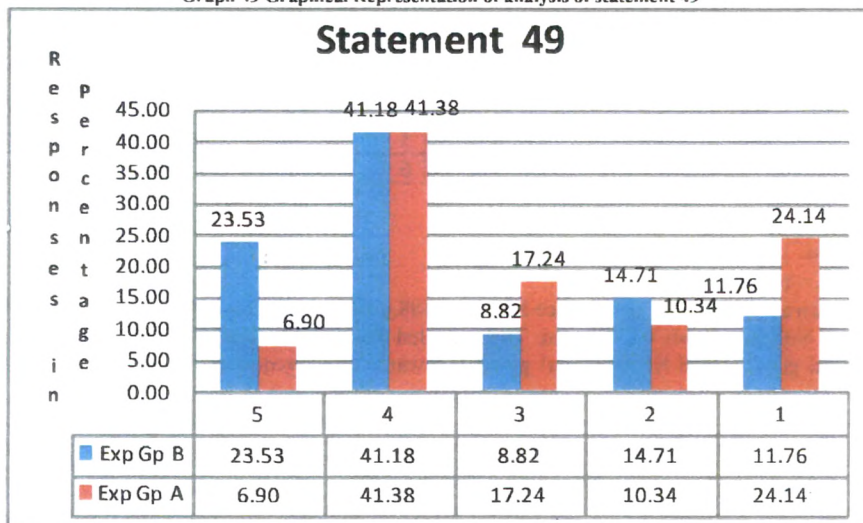| Points	Response of Exp B	Response of Exp A
5	8	2
4	14	12
3	3	5
2	5	3
1	4	7

Chi-square statistics = 5.21
Degree of freedom = 4
Probability of chance =.267

Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 49 Graphical Representation of analysis of statement 49

Statement 49

	5	4	3	2	1
Exp Gp B	23.53	41.18	8.82	14.71	11.76
Exp Gp A	6.90	41.38	17.24	10.34	24.14

Statement 50: Scores obtained by me at the end of each exercise gives me feedback about my learning in each topic through CAI.

Table 52: Responses for statement 50

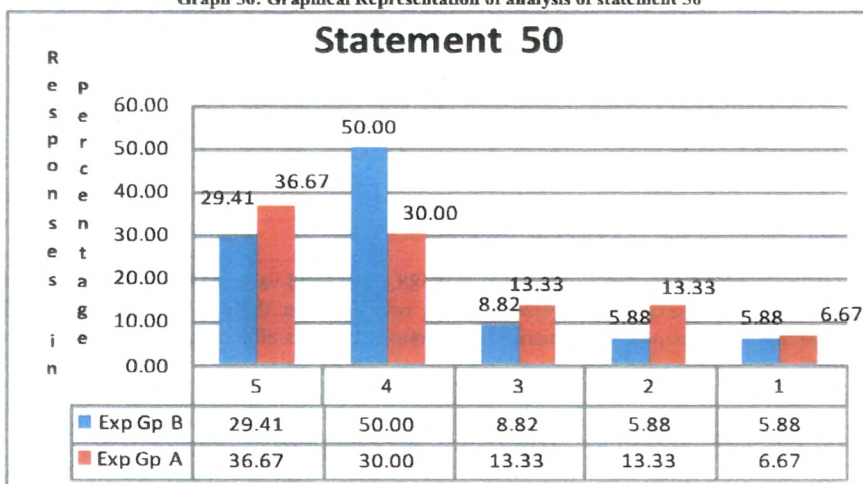| Points	Response of Exp B	Response of Exp A
5	10	11
4	17	9
3	3	4
2	2	4
1	2	2

Chi-square statistics = 3.08
Degree of freedom = 4
Probability of chance =.544
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 50: Graphical Representation of analysis of statement 50

Statement 50

	5	4	3	2	1
Exp Gp B	29.41	50.00	8.82	5.88	5.88
Exp Gp A	36.67	30.00	13.33	13.33	6.67

Statement 51: Discussion with mathematics teacher is needed along with CAI.

Table 53: Responses for statement 51

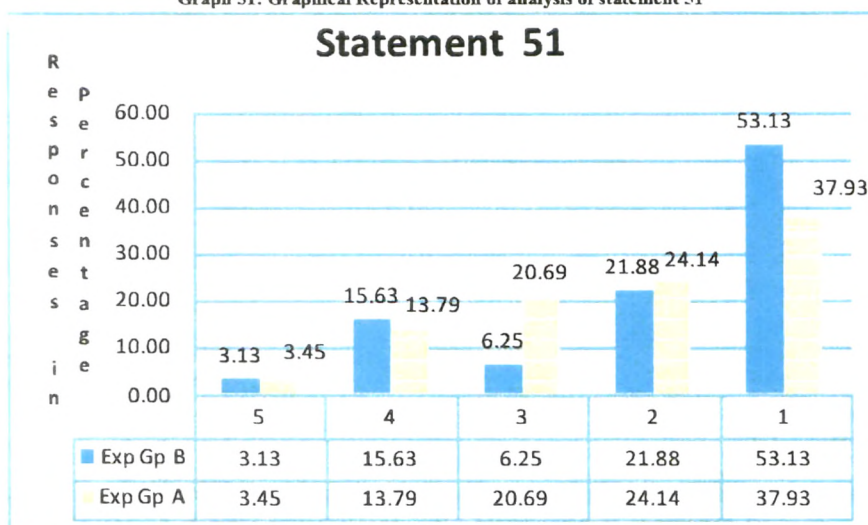| Points	Response of Exp B	Response of Exp A
5	1	1
4	5	4
3	2	6
2	7	7
1	17	11

Chi-square statistics = 3.26
Degree of freedom = 4
Probability of chance =.516

Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 51: Graphical Representation of analysis of statement 51

	5	4	3	2	1
Exp Gp B	3.13	15.63	6.25	21.88	53.13
Exp Gp A	3.45	13.79	20.69	24.14	37.93

Statement 52: Evaluation done at the end of the topic profit and loss is suitable measure to know my understanding about that topic.

Table 54: Responses for statement 52

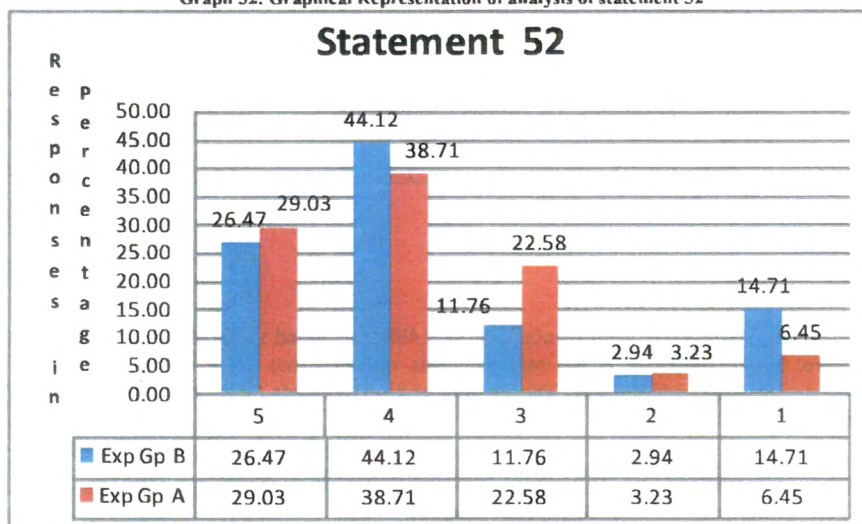| Points	Response of Exp B	Response of Exp A
5	9	9
4	15	12
3	4	7
2	1	1
1	5	2

Chi-square statistics = 2.30
Degree of freedom = 4
Probability of chance =.680
Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 52: Graphical Representation of analysis of statement 52

Statement 52

	5	4	3	2	1
■ Exp Gp B	26.47	44.12	11.76	2.94	14.71
■ Exp Gp A	29.03	38.71	22.58	3.23	6.45

Statement 53: Evaluation done at the end of the topic "simple interest" is suitable measure to know my understanding about that topic.

Table 55: Responses for statement 53

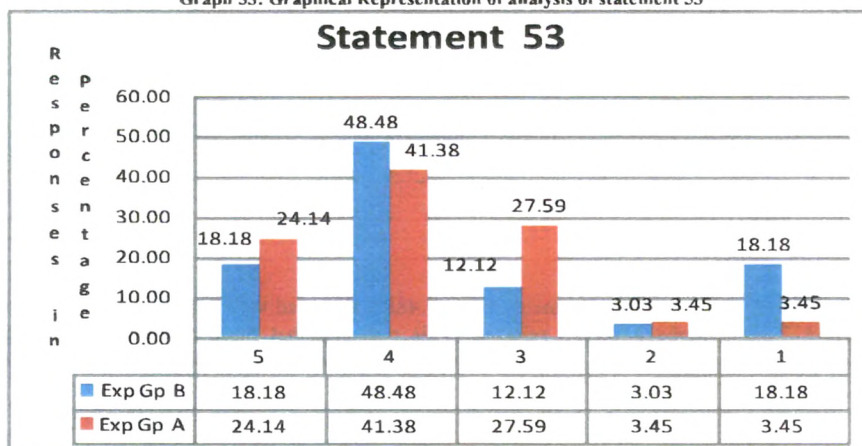| Points	Response of Exp B	Response of Exp A
5	6	7
4	16	12
3	4	8
2	1	1
1	6	1

Chi-square statistics = 5.32
Degree of freedom = 4
Probability of chance =.256

Table value of chi square at 4df at .05 significance level is 9.488. Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 53: Graphical Representation of analysis of statement 53

Statement 53

	5	4	3	2	1
■ Exp Gp B	18.18	48.48	12.12	3.03	18.18
■ Exp Gp A	24.14	41.38	27.59	3.45	3.45

Statement 54: Evaluation done at the end of the topic compound interest is suitable measure to know my understanding about that topic.

Table 56: Responses for statement 54

| Points	Response of Exp B	Response of Exp A
5	5	7
4	12	14
3	5	5
2	1	1
1	10	2

Chi-square statistics = 5.59

Degree of freedom = 4

Probability of chance =.232

Table value of chi square at 4df at .05 significance level is 9.488.Calculated value of Chi Square is less than the table value therefore, Null hypothesis is not rejected. This revealed that there is no significant difference observed between Experimental group A and Experimental group B towards effectiveness of the developed CAI for the given statement.

Graph 54: Graphical Representation of analysis of statement 54

	5	4	3	2	1
Exp Gp B	15.15	36.36	15.15	3.03	30.30
Exp Gp A	24.14	48.28	17.24	3.45	6.90
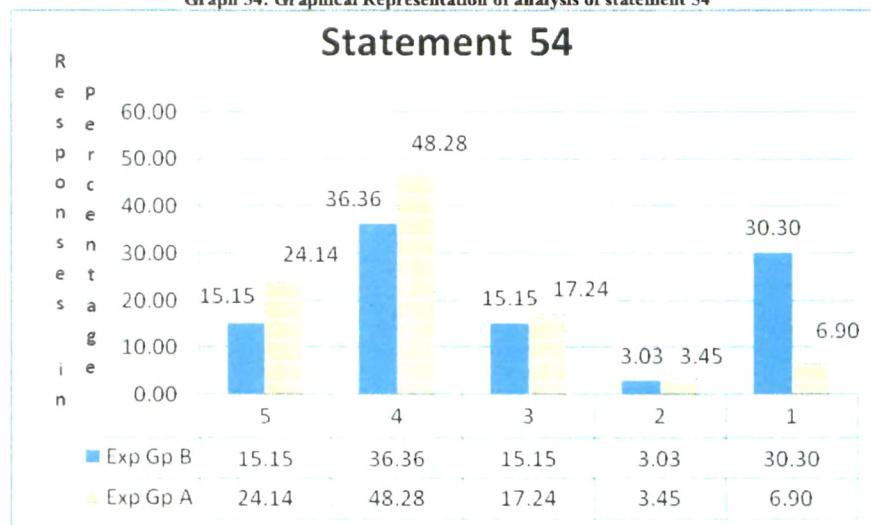
V. FINDINGS OF THE STUDY

Out of 54 statements for four statements (1,2,29, 41) the chi square value is found to be significant which means the Significant difference was observe between Experimental group A and Experimental group B while for remaining 50 statements chi square value is not found to be significant which means that both the group liked the respective way of teaching .

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

Comparing the overall responses of both the groups it seems that out of 54 responses given to the 54 statements on the reaction scale, in four responses for four statements the chi square value is found to be significant which means Significant difference was observe between Experimental group A and Experimental group B while for remaining 50 statements chi square value is not found to be significant. Only CAI is as effective as CAI with simultaneous discussion. Overall responses of the students and from observations of the investigators it was found that students enjoyed learning mathematics through CAI. So it can be concluded that CAI is one of the effective way to teach and learn mathematics.

VIII.   ACKNOWLEDGEMENTS

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2. School administrators who gave permission to conduct our research.
3. Last but not least to all those students participated in our study.

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Students' Reaction on Computer Assisted Instruction for Teaching and Learning Arithmetic

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Abstract

Learning mathematics requires lot of practice and dedication. There are few teachers who can teach this subject interestingly therefore in addition to classroom teaching there should be supplement to students. Self learning material with auto instruction should be developed using psychological theories and concepts. Computer can be used for this purpose because it can provide audio visual effects and also face to face interaction with students is possible. Computers can be utilized to develop auto instructional material with the following facilities viz. self-paced learning, self-directed learning, the exercising of various senses and the ability to represent content in a variety of media. Humans are multi-sensory animals so they learn better if all the senses are involved in the learning process. In this line investigators developed Computer Assisted Instruction and implemented in one of the schools of Vadodara. Three groups were formed control group (taught through usual conventional method), Experimental Group A(taught through only Computer Assisted Instruction(CAI)) and Experimental Group B(taught through CAI with simultaneous discussion). Reaction scale of five points was developed by the investigators and data were analyzed through chi-square test to know the effectiveness of the developed CAI.

Keywords: Computer Assisted Instruction, Effectiveness, Self Learning Material and auto instruction.

Introduction

Education is very important in all stages of human life. It helps man to live a better life and also helps in social well being. It helps in overall development of personality. Especially, mathematics is part and parcel of our life. Learning mathematics not only helps in understanding other subjects but trains one's mind to think logically and rationally. It develops problem solving ability in day to day life and to think precisely. Learning mathematics demands different faculties of mind. A Student may be good in performing calculation but he may have difficulty in solving problems in geometry which demands lot of logical thinking or vice versa. Unlike other science subjects, most of the students have difficulty in learning mathematics because of abstract nature of mathematics. A student can learn other subjects a day before examination but mathematics needs continues practice and dedication. While proving any mathematical principle/theorem it starts with known statement and one statement leads to another by using deductive logic and finally theorem is proved. In the process of proving principle / theorems, steps are logically and rationally followed and this proves the fact that mathematics is science. All theorems are based on previously proved theorem and ultimately based on postulates and axioms. Each and every part of mathematics is based on Postulates and Axioms which ultimately forms the base of mathematics. Thus looking at the nature of mathematics discipline it seems that Computer Assisted Instruction is one of the best methods to teach and learn mathematics subject as Computer Assisted Instruction also follows the principle of logically sequenced frames to deduce the knowledge. Mathematics can be taught in many ways such as laboratory method, drill method and so on. Computer Assisted Instruction (CAI) is one of the way to teach and learn mathematics.

Looking to the importance of teaching of mathematics through Computer Assisted Instruction the investigators have developed Computer Assisted Instruction in the year 2010 to teach mathematics in arithmetic part for class VIII students. The same was tested over standard VIII students and the reactions of these students were studied further.

Learning Mathematics through Computer Assisted Instruction

Computer can play vital role in learning process as it can work with the imagination of students. CAI brings with it several benefits as a teaching/learning medium. These include self-paced learning, self-directed learning, the exercising of various senses and the ability to represent content in a variety of media. Humans are multi-sensory animals. The more senses through which we receive information, the easier it is to remember. According to Fletcher (1990), people remember 20% of what they hear, 40% of what they see and hear and 75% of what they see, hear and do. The fact that the computer can exercise various senses and present information in a variety of media can enhance the learning process. Any concept in mathematics can be explained with the help of pictures and this visual image can help in understanding the concept at ease. In paper pencil method student can get bored easily and can find it difficult to practice the sum again and again. CAI works as a change and increases the curiosity of students and they can learn interestingly without any difficulty.

Rationale of the Study

Many studies have been conducted on low achievements in mathematics. Jain and Burad (1988) 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. Chel (1990) 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. Jeyamani (1991) found that experimental group performed better on post test. The studies conducted by Rose Antony Stella V (1992), Singh (1992), Adhikari (1992), Khirwadkar (1998), Zyoud (1999), Yadav (2000), Dalwadi (2001), Sharma (2003), Helaiya (2004), Barot (2005) and Rathwa (2007) showed that CAI was effective than conventional method. Vansia (2009) in his study found that mathematics learning through CAI with Peer Instruction (CAIPI) was effective on posttest. Many studies on the effects of computer-assisted instruction on the mathematical learning of students of various ages and ability levels suggest that computer-assisted instruction (CAI) as a supplement to traditional classroom

instruction is more effective than traditional instruction alone (Brothen & Wambach, 2000; Butzin, 2000; McSweeney, 2003; Nguyen, 2002; Olusi, 2008). Spradlin & Ackerman(2010) in their research the effectiveness of computer assisted Instruction in Developmental Mathematics conducted quasi experimental study compared academic performance of students enrolled in a developmental mathematics course using traditional instruction (i.e., lecture) and traditional instruction supplemented with computer-assisted instruction. In addition, gender differences in mathematical performance were also investigated. They found that (1) there was no statistically significant difference in the posttest scores of students receiving traditional instruction and traditional instruction supplemented with computer-assisted instruction. (2) There was a significant difference in the posttest scores of females and males, with females outperforming males in both modes of instruction. From the above argument it can be found that computer assisted instruction is effective in most of the cases in teaching and learning mathematics and there were few studies in primary section especially in the arithmetic part. Therefore investigators has developed and implemented CAI and found students reaction on developed CAI.

The Present Study Entitles

Students' reaction on computer assisted instruction for teaching and learning arithmetic

Objectives of the Study

- To study the impact of the developed CAI in terms of responses to the reaction scale given by the students of Experimental Group 'A' who studied through CAI only.
- To study the impact of the developed CAI in terms of responses to the reaction scale given by the students of Experimental Group 'B' who studied through CAI with simultaneous discussion.

Hypotheses of the Study

- Response is uniformly distributed in the 5 point scale for group A students.
- Response is uniformly distributed in the 5 point scale for group B students.

Delimitation of the Study

The present study was delimited to standard VIII English Medium Gujarat Secondary and Higher Secondary Educational Board students in Vadodara city. Only arithmetic unit of the mathematics textbook of standard VIII in the year 2010 was covered during experimentation of the present study.

Methodology 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 investigators in this study. The experimental group A consisted of 28 students and experimental group B consisted of 25 students. Experimental Group A studied through the developed CAI. Experimental Group B studied through the developed CAI along with simultaneous discussions. The total sample for the experiment consisted of 53 students. Students in both the groups learned the same topics of arithmetic viz 'Profit and Loss' and 'Simple and Compound Interest' through the respective instructional strategy. Experiment time duration was 30 periods (each period of 35 minutes) for each the group and experiment went on for full month.

Tools for Data Collection

1) CAI was developed by the investigators and further modified according to the comments given by the experts in the field of Mathematics, Mathematics Education, English and Computer Science

2) Once CAI was finalized by the investigators, the Reaction Scale was developed by the Investigators which was further modified according to the comments given by the experts in the area of Education and English.

Data Analysis and Interpretation

Data were analyzed through the statistical technique χ^2. Data analysis of responses of Group A is presented through table 1 while that of Group B is presented through table 2.

Tabulated Value of χ^2 at 4 df at .05 level is 9.49.

Table 1: Analysis of responses on Reaction Scale given by the Experimental Group A

S.No	Statement	Calculated Value of χ^2 at 4 df .05 level	Significant Difference	Maximum Load
1	I enjoyed this class compared to normal classroom teaching because this method is more interesting to understand than lectures.	12.8	Yes	Positive Side
2	I like illustrations given in the slides, which actually made me learn the lesson.	50.5	Yes	Positive Side
3	Illustrations didn't help me to relate what we learned in mathematics to real life situation.	28.1	Yes	Positive Side
4	CAI is effective way of presentation because there is little stress in learning situation.	12.8	Yes	Neutral
5	I can learn with my own speed.	19.0	Yes	Positive Side
6	I can immediately test myself because there is lot of practice exercise.	16.9	Yes	Positive Side
7	This method is having more freedom to learn.	12.1	Yes	Positive Side
8	CAI didn't focus on more freedom situation.	12.07	Yes	Positive Side
9	Learning mathematics is fun in this CAI method.	10.96	Yes	Positive Side

10	This method is not good in learning mathematics because my doubts are not cleared.	10.2		Yes	Positive Side
11	In CAI I can teach myself (self-study) without the help of others.	13.2		Yes	Positive Side
12	Matter presented in CAI is not very clear.	3.79		No	-
13	CAI is easy to understand.	12.4		Yes	Positive Side
14	Animations are distracting in understanding the concept.	4.14		No	-
15	CAI took more time to understand the concept than usual classroom teaching.	2.00		No	-
16	Illustrations given in CAI are enough to understand the concept clearly.	4.14		No	-
17	Matter presented in CAI was logically arranged.	11.6		Yes	Positive Side
18	Learning through CAI was waste of time.	22.2		Yes	Positive Side
19	Illustrations given in CAI are related to day today life experiences.	14.5		Yes	Positive Side
20	Classroom teaching is more enjoyable.	13.4		Yes	Positive Side
21	The language used in CAI is easy and simple to understand.	33.6		Yes	Positive Side
22	The exercises given in each chapter is adequate.	3.07		No	-
23	CAI takes care of previous knowledge in the subject.	30.6		Yes	Positive Side
24	The solution to the problem is not easy to understand.	3.79		No	-
25	The exercises helped in understanding the chapter in depth.	22.0		Yes	Neutral
26	Solutions didn't help me whenever I was not able to solve the problem.	9.5		Yes	Positive Side
27	Break given in CAI helped me to refresh my mind.	15.0		Yes	Positive Side
28	I am feeling tired while going through the slide.	3.19		No	-
29	Animation shown in CAI is appropriate to help me in understanding the concept.	19.5		Yes	Positive Side
30	Topic is not introduced properly.	12.1		Yes	Positive Side
31	CAI does not take care of previous knowledge (percentage) needed to understand the present concept.	1.70		No	-
32	Enough revision is not done in CAI after the topic simple interest.	0.96		No	-
33	Enough revision is not done in CAI after the topic compound interest.	3.56		No	-
34	Enough revision is not done in CAI after the topic profit and loss.	5.78		No	-
35	Remedial (re teaching the difficult concept which is not understood by you) teaching is not done.	5.78		No	-
36	I have to read the slide many times to understand what is being said as there was no clarity.	6.52		No	-
37	Number of questions at the end of the slides for the topic profit and loss is adequate for providing practice.	12.07		Yes	Positive Side
38	Number of questions at the end of the slides for the topic simple	15.8		Yes	Positive Side

	interest is adequate for providing practice.			
39	Number of questions at the end of the slides for the topic compound interest is adequate for providing practice.	2.07	No	-
40	CAI is not enough in understanding the concept very clearly.	2.81	No	-
41	Independent learning is not possible through CAI.	9.85	Yes	Positive Side
42	Evaluation is done objectively (objective questions) so no partiality is involved in scoring.	18.4	Yes	Positive side
43	Evaluation done at the end of the topic "simple interest" is not suitable measure to know my understanding about that topic.	3.19	No	-
44	Instruction given in each slide of CAI is easy and clear to follow.	13.6	Yes	Positive Side
45	Evaluation done at the end of the topic profit and loss is not suitable measure to know my Understanding about that topic.	0.96	No	-
46	Interaction with mathematics teacher is not possible while using this CAI (no face to face interaction).	1.70	No	-
47	To get the correct answer I had to go back to the slide/s many times for topic simple interest.	7.26	No	-
48	To get the correct answer I had to go back to the slide/s many times for topic Compound interest.	10.2	Yes	Neutral
49	To get the correct answer I had to go back to the slide/s many times for topic profit and loss.	6.15	No	-
50	Scores obtained by me at the end of each exercise gives me feedback about my learning in each topic through CAI.	11.7	Yes	Neutral
51	Discussion with mathematics teacher is needed along with CAI.	3.56	No	-
52	Evaluation done at the end of the topic profit and loss is suitable measure to know my understanding about that topic.	5.41	No	-
53	Evaluation done at the end of the topic "simple interest" is suitable measure to know my understanding about that topic.	8.74	No	-
54	Evaluation done at the end of the topic compound interest is suitable measure to know my understanding about that topic.	4.67	No	-

Table 2: Analysis of responses on Reaction Scale given by the Experimental Group B

S.No	Statement	Calculated Value of χ^2 at 4 df .05 level	Significant Difference	Maximum Load
1	I enjoyed this class compared to normal classroom teaching because this method is more interesting to understand than lectures.	17.2	Yes	Positive Side
2	I like illustrations given in the slides, which actually made me learn the lesson.	19.3	Yes	Positive Side

3	Illustrations didn't help me to relate what we learned in mathematics to real life situation.	13.9	Yes	Neutral
4	CAI is effective way of presentation because there is little stress in learning situation.	23.1	Yes	Neutral
5	I can learn with my own speed.	28.1	Yes	Positive Side
6	I can immediately test myself because there is lot of practice exercise.	12.7	Yes	Positive Side
7	This method is having more freedom to learn.	11.00	Yes	Positive Side
8	CAI didn't focus on more freedom situation.	4.75	No	-
9	Learning mathematics is fun in this CAI method.	14.3	Yes	Positive Side
10	This method is not good in learning mathematics because my doubts are not cleared.	1.4	No	-
11	In CAI I can teach myself (self-study) without the help of others.	4.75	No	-
12	Matter presented in CAI is not very clear.	9.75	Yes	Positive Side
13	CAI is easy to understand.	5.17	No	-
14	Animations are distracting in understanding the concept.	12.25	Yes	Positive Side
15	CAI took more time to understand the concept than usual classroom teaching.	3.08	No	-
16	Illustrations given in CAI are enough to understand the concept clearly.	6.0	No	-
17	Matter presented in CAI was logically arranged.	3.5	No	-
18	Learning through CAI was waste of time.	11.8	Yes	Neutral
19	Illustrations given in CAI are related to day today life experiences.	17.2	Yes	Positive Side
20	Classroom teaching is more enjoyable.	2.8	Yes	Positive Side
21	The language used in CAI is easy and simple to understand.	13.2	Yes	Positive Side
22	The exercises given in each chapter is adequate.	10.58	Yes	Positive Side
23	CAI takes care of previous knowledge in the subject.	13.3	Yes	Neutral
24	The solution to the problem is not easy to understand.	2.25	No	-
25	The exercises helped in understanding the chapter in depth.	6.83	No	-
26	Solutions didn't help me whenever I was not able to solve the problem.	6.35	No	-
27	Break given in CAI helped me to refresh my mind.	11.4	Yes	Positive Side
28	I am feeling tired while going through the slide.	10.40	Yes	Positive Side
29	Animation shown in CAI is appropriate to help me in understanding the concept.	11.8	Yes	Positive Side
30	Topic is not introduced properly.	11.2	Yes	Positive Side
31	CAI does not take care of previous knowledge (percentage) needed	2.43	No	-

	to understand the present concept.			
32	Enough revision is not done in CAI after the topic simple interest.	2.00	No	-
33	Enough revision is not done in CAI after the topic compound interest.	4.00	No	-
34	Enough revision is not done in CAI after the topic profit and loss.	1.13	No	-
35	Remedial (re teaching the difficult concept which is not understood by you) teaching is not done.	3.74	No	-
36	I have to read the slide many times to understand what is being said as there was no clarity.	5.17	No	-
37	Number of questions at the end of the slides for the topic profit and loss is adequate for providing practice.	11.6	Yes	Positive Side
38	Number of questions at the end of the slides for the topic simple interest is adequate for providing practice.	9.75	Yes	Positive Side
39	Number of questions at the end of the slides for the topic compound interest is adequate for providing practice.	14.4	Yes	Positive Side
40	CAI is not enough in understanding the concept very clearly.	2.67	No	-
41	Independent learning is not possible through CAI.	2.67	No	-
42	Evaluation is done objectively (objective questions) so no partiality is involved in scoring.	16.4	Yes	Positive side
43	Evaluation done at the end of the topic "simple interest" is not suitable measure to know my understanding about that topic.	9.75	Yes	Positive Side
44	Instruction given in each slide of CAI is easy and clear to follow.	22.7	Yes	Positive Side
45	Evaluation done at the end of the topic profit and loss is not suitable measure to know my Understanding about that topic.	6.42	No	-
46	Interaction with mathematics teacher is not possible while using this CAI (no face to face interaction).	2.25	No	-
47	To get the correct answer I had to go back to the slide/s many times for topic simple interest.	3.92	No	-
48	To get the correct answer I had to go back to the slide/s many times for topic Compound interest.	3.50	No	-
49	To get the correct answer I had to go back to the slide/s many times for topic profit and loss.	3.08	No	-
50	Scores obtained by me at the end of each exercise gives me feedback about my learning in each topic through CAI.	10.6	Yes	Positive Side
51	Discussion with mathematics teacher is needed along with CAI.	5.58	No	-
52	Evaluation done at the end of the topic profit and loss is suitable measure to know my understanding about that topic.	16.4	Yes	Neutral
53	Evaluation done at the end of the topic "simple interest" is suitable measure to know my understanding about that topic.	13.1	Yes	Positive Side
54	Evaluation done at the end of the topic compound interest is suitable measure to know my understanding about that topic.	12.7	Yes	Positive Side

Findings of the Study

The findings are listed below first for Experimental Group A and then for Experimental Group B.

Experimental Group A

Out of total *fifty four* statements bearing positive as well as negative nature, the computed chi-square values of *twenty six* statements were found to have statistically significant *higher values than the tabulated value of chi-square* at 4 degrees of freedom and at .05 level of significance which shows that there was a significant difference between the observed and expected frequencies and the students *were found to have positive reaction and favorable attitude towards the statements carrying such higher values.*

The computed chi-square values in *twenty four* statements were *not found to be significant* at 4 degrees of freedom and at .05 level of significance which shows that there was no significant difference between the observed frequency and expected frequency therefore null hypothesis is not rejected. This reveals that reaction is *uniformly distributed* in the 5-point scale.

The computed chi-square values of remaining *four statements* were found to have statistically significant higher values than the chi-square table value at 4 degrees of freedom and at .05 level of significance which shows that there was a significant difference between the observed and expected frequencies and the students *were found to have neutral attitude* towards the statements carrying such higher values.

Experimental Group B

Out of total *fifty four* statements bearing positive as well as negative nature, *the computed chi-square values of twenty five statements were found to have statistically significant higher values than the chi-square table values* at 4 degrees of freedom and at .05 level of significance which shows that there was a significant difference between the observed and expected frequencies and the students were found to have positive reaction and favorable attitude towards the statements carrying such higher values.

The computed chi-square values in *twenty four* statements were *not found to be significant at* 4 degrees of freedom and at .05 level of significance which shows that there was no significant difference between the observed frequency and expected frequency therefore null hypothesis is not rejected. This reveals that reaction is uniformly distributed in the 5-point scale.

The computed chi-square values of remaining *five statements* were found to have statistically significant higher values than the chi-square table values 9.49 at 4 degrees of freedom and at .05 level of significance which shows that there was a significant difference between the observed and expected frequencies and the students *were found to have neutral attitude* towards the statements carrying such higher values.

Conclusion

Comparing the overall responses of both the groups it seems that out of 54 responses given to the 54 statements on the reaction scale, the Experimental Group A shows twenty six responses towards positive side while that of Group B twenty five towards positive side. Thus clearly shows almost 50% of the statements show positive responses in both the groups. It should be also noted that in Experimental Group A four responses are neutral while in Experimental Group B five responses are neutral towards statements four and five respectively. Also in Experimental Group A for twenty four statements the responses were uniformly distributed while in Experimental Group B responses to the twenty five statements were found to be uniformly distributed. *Hence it can be concluded that overall reaction of the students of both the groups toward CAI developed by the investigators for teaching of arithmetic is effective.*

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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
The Effectiveness of Computer Assisted Instruction in Teaching Arithmetic

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 con-ducting 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)

S.No	X	Y	X*X	Y*Y	X*Y
	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)

S.No	X VII Marks out of 100	Y Post Test out of 100	X*X	Y*Y	X*Y
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			

Table 3: Calculation of ANCOVA Experimental Group B (CAI with simultaneous discussion)

s.n	x vii marks out of 100	y post test out of 100	x*x	y*y	x*y
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	0.000000000010
	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		Group
Means			Adjusted	
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 v1 = 2 and v2 = 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 v1 = 2 and v2 = 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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