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Reaction of Students on Developed Computer Assisted Instruction for Teaching Arithmetic

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Abstract Mathematics uses special language called Set language. Students find mathematics difficult to understand because symbols occupy important place in mathematics. Nature of mathematics inculcates good values among students viz thinking precisely, acceptance after verification, parsimony, rational and logical thinking, and hard work. Practice and dedication is required to understand the subject. 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 express 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 tested its effectiveness.

Keywords Computer Assisted Instruction, Effectiveness, Self-Learning Material and Auto Instruction

1. 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[1]. 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 today 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 mathematics is of abstract nature. A student can learn other subjects a day before examination but mathematics needs continues practice and dedication. This very fact makes learning mathematics difficult. Mathematics can be taught in many ways like laboratory method, drill method etc Computer Assisted Instruction (Computer Assisted Instructions) is one of the way to teach mathematics. Researchers have developed Computer Assisted Instructions to teach mathematics in arithmetic part for class VIII students.

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2. Nature of Mathematics

Mathematics is the oldest field of study and it is the central component of human thought. In natural sciences inductive logic is used to develop a concept but mathematics always uses deductive logic. It can be considered as an art and science. It can be considered as an art because of its aesthetic value. When a mathematical problem is solved it gives pleasure and satisfaction to the solver. While proving theorems, steps are logically and rationally followed and this proves the fact that mathematics is science. While proving a theorem it starts with known statement and one statement leads to another by using deductive logic and finally theorem is proved. 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. It differs from natural science because of its abstract nature. A mathematical theorem deals with some particular natural facts, its adherence is not for each of these facts but to making logical deductions from these facts. All theorems are based on some facts but theorem ones proved, its result is relatively permanent unlike natural science where results are subject to change. To cite an example atom was considered indivisible, latter on it was discovered that it contains

subatomic particles, this discovery changed the previous assumption.

3. Computer Assisted Instruction in Learning Mathematics

Computer can play vital role in learning process as it can work with the imagination of students.[2] CAI brings with it several potential 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[3] 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.[4] 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 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.

4. Rationale of the Study

Many studies have been conducted on low achievement in mathematics.[5]These auhors 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.[6] 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.[7] Author found that experimental group performed better on post test. The studies conducted by authors[8-18] showed that CAI was effective than conventional method.[19] Author in his study found that mathematics learning through CAI with Peer Instruction (CAIPI) was effective on posttest. Investigators reviewed the above mentioned studies and found that there was no study conducted in arithmetic part of mathematics which forms the building block for learning algebra and there were no studies related to upper primary section which forms a bridge to secondary section. In this line investigators felt a need to conduct research in this field and this research is the result.

5. Methodology of the Study

5.1. The Present Study Entitles

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5.2. Objectives of the Study

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

5.3. 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.

5.4. 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.

5.5. Design of the Study

The study adopts the post test only control group design.

5.6. 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.

5.7. Sample and Procedure of the Study

One school in the urban area was selected on the basis of the computer facilities available in their campus for conducting the experiment. Random sampling technique was used to select groups by the researchers in this study. The experimental group A consisted of 28 students and experimental group B consisted of 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 viz 'Profit and Loss' and 'Simple and Compound Interest' through the respective instructional strategy. Experiment time duration was 30 periods in both the groups.

5.8. 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.

6. Data Analysis and Interpretation

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.

[20] 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 outcomes.

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

We can calculate X^2:

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

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

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

Statement	Calculated Value of χ^2 at 4 df .05 level	Significant Difference	Maximum Load
1	14.62	Yes	Positive Side
2	51.52	Yes	Positive Side
3	8.07	No	-
4	13.93	Yes	Neutral Side
5	22.33	Yes	Positive Side
6	23.24	Yes	Positive Side
7	21.67	Yes	Positive Side
8	5.31	No	
9	21.86	Yes	Positive Side
10	3.67	No	
11	5.31	No	
12	11.33	Yes	Positive Side
13	14.62	Yes	Positive Side
14	5.92	No	
15	7.33	No	
16	10.67	Yes	Positive Side
17	21	Yes	Positive Side
18	19.00	Yes	Positive Side
19	24.00	Yes	Positive Side
20	17.00	Yes	Negative Side
21	19.79	Yes	Positive Side
22	20.19	Yes	Positive Side
23	12.33	Yes	Positive Side
24	3.03	No	
25	14.00	Yes	Positive Side
26	8.76	No	

27	6.34	No	
28	1.17	No	
29	14.62	Yes	Positive Side
30	14.97	Yes	Positive Side
31	10.83	Yes	Positive Side
32	10.81	Yes	Positive Side
33	5.33	No	
34	6.67	No	
35	3.93	No	
36	2.89	No	
37	6.00	No	
38	11.00	Yes	Positive Side
39	13.94	Yes	Equal P+ Equal N
40	9.00	No	
41	5.31	No	
42	7.38	No	
43	9.80	Yes	Neutral Side
44	19.10	Yes	Positive Side
45	7.72	No	
46	6.69	No	
47	8.07	No	
48	4.62	No	
49	10.83	Yes	Positive Side
50	9.67	Yes	Positive Side
51	9.45	No	
52	14.00	Yes	Positive Side
53	15.6	Yes	Positive Side
54	18.41	Yes	Positive Side

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

Statement	Calculated Value of χ^2 at 4 df .05	Significant Difference	Maximum Load
	level		
1	16.29	Yes	Positive Side
2	6.6	No	
3	6.85	No	
4	7.45	No	
5	11.39	Yes	Positive Side
6	16.54	Yes	Positive Side
7	8.65	No	
8	15.33	Yes	Positive Side
9	11.69	Yes	Positive Side
10	8.06	No	
11	14.72	Yes	Positive Side
12	6.24	No	
13	13.82	Yes	Positive Side
14	26	Yes	Positive Side
15	11.39	Yes	Negative Side
16	8.06	No	
17	15.63	Yes	Positive Side
18	15.64	Yes	Positive Side
19	16.44	Yes	Positive Side
20	3.52		
21	17.15	Yes	Positive Side
22	10.18	Yes	Positive Side
23	17.15	Yes	Positive Side
24	17.43	Yes	Positive Side
25	8.17	No	
26	11.43	Yes	Positive Side
27	5.94	No	
28	14.12	Yes	Positive Side
29	2.60	No	
30	11.09	Yes	Positive Side
31	9.27	No	
32	11.59	Yes	Positive Side
33	5.31	No	
34	5.94	No	
35	16.44	Yes	Negative Side
36	13.65	Yes	Positive Side
37	15.50	Yes	Positive Side
38	13.52	Yes	Positive Side
39	5.33	No	
40	3.82	No	
41	28.97	Yes	Positive Side
42	14.73	Yes	Positive Side
43	6.85	No	
44	12.60	Yes	Positive Side
45	3.21	No	
46	12.91	Yes	Negative Side
47	15.94	Yes	Positive Side
48	8.94	No	
49	11.59	Yes	Positive Side
50	25.71	Yes	Positive Side
51	25.5	Yes	Negative Side
52	17.18	Yes	Positive Side
53	19.27	Yes	Positive Side
54	11.69	Yes	Positive Side

7. Findings of the Study

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

7.1. Experimental Group A

Out of total *54* statements bearing positive as well as negative nature, the computed chi-square values of *27* statements were found to have statistically significant *higher values* at .05 level of significance. This outcomes indicates there was a significant difference between the observed and expected frequencies. Also, 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 *25* 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 was accepted. The computed chi-square values of remaining *two statements* were found to have statistically significant higher values. This difference was statistically significant.

The computed chi-square values of *one statement* was 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 *equal number* of students were found to have *positive reaction* as well as equal number of *negative reaction* towards the statement.

7.2. Experimental Group B

Out of total *54* statements bearing positive as well as negative nature, *the computed chi-square values 31 statements were found to have statistically significant.*

The computed chi-square values for 19 *statements* were *not found to be significant.*

The computed chi-square values of remaining *four 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 *negative attitude* towards the statements carrying such higher values.

8. Conclusions

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 made 27 responses that were positive while that of Group B 31 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 two responses were neutral towards two statements. Also in Experimental Group A for the 24 statements the responses were uniformly distributed while in Experimental Group B responses to the 19 statements were found to be uniformly distributed. Experimental group B shows four responses toward negative side for four statements. 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 was similar.

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