EFFECTS OF COMPUTER ASSISTED INSTRUCTION (CAI) ON THE TEACHING OF CURRENT ELECTRICITY AT HIGHER SECONDARY LEVEL

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**ABSTRACT**

The concept of Educational technology has been developed during the last few years. Educational Technology has given a significant contribution in education by taking into consideration the individual differences of the learners and catering to their needs. The emerging trend all over the world is towards more individualized and flexible forms of learning with an emphasis on the individualized methods of instructions. Bloom’s Taxonomy of instructional objectives has a great impact in teaching learning process. This paper has laid a special emphasis on using computers in the teaching and learning process specially for providing instructions in the classroom situations. It is an experimental work to study the effect of Computer Assisted Instruction (CAI) and Traditional Method in cognitive domain for teaching current electricity of Physics Curriculum at Higher Secondary level. The experiment was carried out on the students of class XII having Physics as one of their subjects of a higher secondary school. Pretest-Posttest equivalent group design is used. Results of the experiment showed that CAI is effective in terms of the cognitive achievement of learner in teaching current electricity at Post test stage.

**INTRODUCTION**

The main aim of education is to preserve, transmit and advance knowledge. In the past, this aim was achieved with the help of teachers, books and some audio visual aids. But a number of problems were encountered in the promotion of education. These include problems of large classes, heterogeneous classes with individual differences, lack of...
textbooks and source materials etc. Moreover, due to information explosion the objectives of Education have become multidimensional. It is difficult to achieve those objectives by using lecture method only. There is a need of some flexible methods of teaching. The solution of these problems can only be tackled by the use of technology in the education system.

The rapid developments in the instructional technology are Programmed Instruction (PI), Computer Based Instruction (CBI), Computer Based Learning (CBL), Modular Approach, Web Based Learning (WBL) and Computer Assisted Instruction (CAI). These can be used to take care of the individual differences. All of these methods can be adjusted to the individual's pace of learning and useful for imparting individualized instructions. Among these self-learning methods Computer Assisted Instruction (CAI) has influenced the teachers to use it for teaching. Now-a-days, CAI is being used for providing instructions to the students at different levels to update their knowledge. CAI is one of the most useful methods of providing individualized and self paced instructions to the learners in classroom situations. It covers a wider range of individual differences. It is used for presenting the instructional material automatically to the learners.

In recent years, a number of factors have prompted change in the teaching of physics, particularly at upper secondary and undergraduate levels. Changes have been made in the development of courses and curricula and in the teaching methods. Advancing technology has opened many doors in physics education. The use of computer based teaching in physics provides number of alternatives to students such as visualization of abstract concepts that will foster student understanding. These alternatives would be complementary to traditional teaching. Computer assisted instructional materials are more effective in developing favorable attitude, and in capturing interest towards learning physics. The computer simulations prepared to be used in teaching activities are able to create a teaching atmosphere like laboratories where students are active. A variety of visual representations of physics concepts in the computer simulations make concepts visible that are otherwise invisible to students.

Computer Assisted Instruction (CAI) has been proving an effective medium of education in the advanced countries for formal and non-formal education at all the levels. The use of computers in the classroom has boomed since the 1980s but studies within the past 15-20 years have focused on the relationship between CAI and academic achievement in many different subject areas. Number of studies has been carried out to find the effectiveness of CAI at different levels. Some of these are:

Dalton and Hannafin (1986), Richardson (1986), Price (1989), Roberts and Madhere (1990), Rha and Bedell (1998), Hsiao (2001) and Raninga (2010) carried out the studies to find out the effectiveness of CAI in teaching learning of Mathematics at different levels. They found a good increase in scores of the learners by using CAI. It was found that secondary students exposed to CAI showed higher academic achievement than the students exposed to traditional instructions.

In the World and in Turkey, a lot of researches have been done about CAI. These researches resulted in very different results. Some of the researchers found CAI as useful for students’ development. Cotton (1991); Morse (1991); Child (1995); Brophy (1999); Çekbagö, et al., (2003); Yenice (2003); Carter (2004); Moodly (2004); Preciado (2004); Brooks (2005); Bryan (2006); Çepni, et al., (2006); Wilder (2006); Liao (2007) have
Banik et al., (2017) performed a lot of work on the effectiveness of CAI and found its positive impact on teaching learning process. Tambade and Gobji Wagh (2011) studied on the effectiveness of CAI in physics at undergraduate level and found that students had acquired a good general understanding in the area of verbal, vector and diagrammatic representation of the abstract physics concepts. Kausar, Choudhry and Gujjar (2008) have done a comparative study to evaluate the effectiveness of CAI versus Class room lecture for computer science at ICS level and found that total gain in cognitive domain by CAI was significantly superior to the total gain in cognitive domain by CRL teaching method.

Ramani and Patadia (2012) studied the effectiveness CAI in teaching Arithmetic. They found that CAI with simultaneous discussion is more effective than traditional method. Mahmood (2004) conducted a study on CAI and traditional method of instruction. This study examined the effect of computer-assisted instruction on student achievement in general science as compared to traditional method of instruction. The result revealed that the experimental group outperformed the control group in all achievement areas i.e. overall, by levels of cognitive domain and by type of content. Students like the CAI program and benefited from it. They found it better mode of instruction than the traditional method.

Mintz (2000) and Campbell (2000), as quoted by Mahmood (2004), compared computerized and traditional instruction in the area of elementary Mathematics and elementary reading. It was found that there was significant difference in critical thinking skills between students who received CAI and students that did not.

A qualitative study aimed to ascertain the worth of CAI program for intermediate Algebra course was conducted by Miller (1999), as quoted by Mahmood (2004), The main point concerning CAI that emerges from this study was the benefits to students of immediate feedback from the computer. And the value of interaction as a means of learning Mathematics and the advantage of individualized instruction.

In recent years a number of factors have prompted change in the teaching of physics particularly at upper secondary and undergraduate levels. Changes have been made in the development of courses and curricula and in the teaching methods. This has been happening across the world. Changes to courses, curricula and instructional methods, or in some cases, the contemplation of changes, have been driven by concerns about traditional teaching methods. Advancing technology has opened many doors in physics education.

Meltzer & Manivannan (2002) have shown that the use of computer based teaching in physics provides number of alternatives to students such as visualization of abstract concepts that will foster student understanding. These alternatives would be complementary to traditional teaching. Azar & Sengulec (2011) reflected the effectiveness of Computer assisted instructional materials in developing favorable attitude, and in capturing interest towards learning physics. The activities that aid student the visualization of abstract concepts will foster their conceptual understanding.

Perkins, et al., (2006) studied the effect of computer simulations and it seems to be one of the most effective ways to use computers in physics education. The computer simulations prepared to be used in teaching activities are able to create a teaching atmosphere like laboratories where students are active.

Finkestein, et al., (2005) had shown that a variety of visual representations of physics concepts in the computer simulations make concepts visible that are otherwise invisible to students. Higher secondary level is a vital stage of education because after these
course students especially science students are able to choose different professional courses through various entrance examination which requires a sound conception and thinking of physics. The present study aims to investigate whether computer assisted instruction is more effective in teaching current electricity at higher secondary level than traditional method of instruction.

MATERIALS AND METHODOLOGY

In an effort to explicate the specific intentions of our educational system, Benjamin S. Bloom (1956) and his colleagues published taxonomy of Educational Objectives in the cognitive domain. According to him, the taxonomy is designed to be a classification of the student behaviors which represent the intended outcomes of the educational process. His taxonomy consists of six major classes which are arranged in hierarchical order from simple to complex. The major classes of Bloom’s Taxonomy are knowledge, comprehension, application, analysis, synthesis and evaluation. The use of computer technology to supplement traditional instruction to develop concept of content in physics like current electricity among students at higher secondary level is a recent development. Although considerable research indicates that computer-assisted instruction can have a positive impact on learning for students of all ages and in a variety of content areas, the research is limited for students in development of conception in physics. Some researchers think that computer-assisted instruction has great potential for improving concepts in science education. Others contend, however, that science students need personal interaction with an instructor and other students. Higher secondary level is a vital stage of education because after these course students especially science students are able to choose different professional courses through various entrance examination which requires a sound conception and thinking of physics. Does computer-assisted instruction enhance the learning of current electricity or is traditional method of instruction more effective for these students?

2.1 Objectives of the Study

The objectives are to compare the learning effects of two groups of learners studying the same physics curriculum. One group will use traditional instruction; the other use CAI format instruction. The investigator attempts–

1. To develop computer assisted instructional package on the topic Current Electricity of Physics curriculum.
2. To compare the mean scores related to the cognitive achievement of the control group and experimental group in their pre test.
3. To study whether there is significant difference in the scores related to the cognitive achievement of pre test and post test of the control group.
4. To find out whether there is significant difference in the scores related to the cognitive achievement of pre test and post test of the experimental group.
5. To compare the scores related to the cognitive achievement obtained by the control group and experimental group in their post test.
2.2 Hypothesis

Depending on the objectives of the study the following hypotheses are formulated below:

(a) There exists no significant difference between the mean scores related to cognitive achievement of control group and experimental group in the pre test.
(b) There exists no significant difference between the mean scores related to cognitive achievement of pre test and post test of the control group.
(c) There is a significant difference between the pre test and post test gain scores of cognitive achievements of the experimental group.
(d) There is a significant difference between the post test scores of cognitive achievement of control group and experimental group.

2.3 Limitations and Delimitations

1. Computer use is limited to the presentation of curriculum only.
2. The higher secondary schools under Tripura board of secondary education are selected only.
3. The subjects of the study are limited to higher secondary level Physics only.
4. The sample include girls and boys as study subjects; average age of 17-18 years, of different ethnic backgrounds from two different higher secondary schools.
5. Learners use Bengali/English as an instructional medium.

2.4 Research Design

The research is true-experimental in nature because the equivalence of the control and experimental groups are provided by random assignment of subjects to experimental and control treatments. The research design followed by researcher will be the Pre-test - Post Test Equivalent Groups Deign.

2.5 Sampling and Tools

All students of physics of higher secondary level from different schools of Tripura are the population of this study. However, the researcher has taken student from one school under Tripura Board of Secondary education as the sample of the study. In order to get wide random samples, total 60 students are selected for the said study. The study is conducted in the institution having all well-equipped CAI and traditional instruction lab facilities. The independent variable is the mode of instruction, and the dependent variable will be performance on current electricity as measured by the post test.

A multiple choice question (MCQ) test containing 30 items will be constructed and pilot tested, item analysis will be done by measuring difficulty level and item discrimination index.

2.6 Procedure of the Study

In order to avoid the inter personal and intra personal variation of two different teachers for CAI and Traditional Instruction groups, it is decided to conduct the both classes by a single teacher having a competence to conduct both CAI and traditional instructions side by side on the same dates. Two designs of experimental curriculum will be formed, one for CAI and other for Traditional instruction. The CAI format lessons will
install on the hard disks of the personal computers. A selected room with desks, chairs, paper, clock, and a white board was used for the traditional instruction.

**Construction of Tools:** The investigator has constructed an achievement test in physics on the topic of current electricity of class XII according to the syllabus of Tripura board of secondary education. The achievement test containing 30 multiple choice question (MCQ) type items was constructed and pilot tested. Item analysis was done by measuring the difficulty level and item discrimination index. Difficulty level from 0.5 to 0.7 and discrimination index from 0.35 to 0.50 was considered the appropriate. The reliability coefficient was found to be 0.81 which were depicted the reliability of the tool. The final form of the scale containing 25 items was used as an achievement test. The same test will be used in pretest as well as in post test.

**Administration of the test:** The investigator has selected one of the prominent govt. English medium school of Agartala, Tripura for her research work. The researcher has been selected 60 students of class XII. The basic parameter of the selection was the academic achievement of the student in their Madhyamik examination conducted by Tripura Board of Secondary Examination. Those students obtained 60% marks or above in physical science in the board examination are selected as samples for the said study. Then 60 students are divided into two groups named experimental group and control group containing 30 students in each group. Each group contains both boys and girls. The Test was administered on these 60 students on the same day and same time.

### 2.7 Data Collection

Data is collected from both the group i.e. both from experimental and control group by giving them a test consisted of 25 items, which will focus the Cognitive Development of learners’ achievement in the field of current electricity.

The achievement test is administered on both experimental and control groups. This test is taken as pretest of the study. Next the experimental group is taught by using CAI material and the control group is taught by traditional lecture method. After that again the same achievement test is administered on both experimental and control group. This test is taken as post test of the study.

### RESULTS

The response of students to CAI has been overwhelmingly positive. ‘t’ tests for comparison of pre and post –test means have revealed that CAI has in every case led to increased achievement. The following findings are obtained from the study.

1. The result of present study reveals that the cognitive achievement in the topic current electricity for both the experimental and control group is almost same in the pre test.

2. The result of the present study clearly points out the significant increase in the mean scores that has been found in the post test scores of the experimental group.

3. The study points out the positive impact of CAI on total cognitive achievement in post test of experimental group.
4. It is found from the study that the experimental group whose mean score was slightly less than control group in pretest has possessed sufficiently higher mean score in posttest.

DISCUSSION

Collected data are analyzed statistically in terms of mean scores and standard variation. To find the significance of the difference between pre and post test scores t-test was applied. Licensed SPSS latest version is used here. Results and Findings are discussed with suitable interpretation.

Table – 1: Control vs. Experimental Group with Respect to Total Cognitive Achievement in Pre-Test

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t - value</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>30</td>
<td>12.46</td>
<td>3.91</td>
<td>58</td>
<td>0.30</td>
<td>NS</td>
</tr>
<tr>
<td>Experimental</td>
<td>30</td>
<td>12.16</td>
<td>3.63</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS = Not Significant

Table 1 shows that the mean cognitive achievement score in the pretest are 12.46 and 12.16 for control and experimental group. The t – value is 0.30 which is not significant at 0.01 levels. Hence it can be inferred that there is no significant difference between control and experiment group in the pretest. Hence H1 is accepted.

Table – 2: Control Group in the Pre and Post Test with Respect to Total Cognitive Achievement

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t - value</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>30</td>
<td>12.46</td>
<td>3.91</td>
<td>58</td>
<td>6.95</td>
<td>Significant</td>
</tr>
<tr>
<td>Posttest</td>
<td>30</td>
<td>17.73</td>
<td>3.01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 shows the mean cognitive achievement of control group is 12.46 and 17.73 in pretest and posttest respectively. The t - value is 6.95 which is significant at 0.01 level. This means that the total cognitive achievement of the control group that is the group that is taught by traditional method shows a gain in total cognitive achievement. Hence H2 is rejected.

Table – 3: Experimental Group in the Pre and Post Test with Respect to Total Cognitive Achievement

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t - value</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>30</td>
<td>12.16</td>
<td>3.63</td>
<td>58</td>
<td>11.792</td>
<td>Significant</td>
</tr>
<tr>
<td>Posttest</td>
<td>30</td>
<td>21.40</td>
<td>2.22</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows that the mean cognitive achievement of Experimental group is 12.16 and 21.40 in pretest and posttest respectively. The t-value is 11.792 which is highly significant at 0.01 level. This means that the total cognitive achievement of experimental
group, i.e., the group taught by CAI format shows a gain in total cognitive achievement. Hence H3 is accepted.

Table – 4: Experimental Group in the Pre and Post Test with Respect to Total Cognitive Achievement

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t-value</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>30</td>
<td>12.16</td>
<td>3.63</td>
<td>58</td>
<td>11.792</td>
<td>Significant</td>
</tr>
<tr>
<td>Posttest</td>
<td>30</td>
<td>21.40</td>
<td>2.22</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 shows that the mean cognitive achievement of Experimental group is 12.16 and 21.40 in pretest and posttest respectively. The t-value is 11.792 which is highly significant at 0.01 level. This means that the total cognitive achievement of experimental group, i.e., the group taught by CAI format shows a gain in total cognitive achievement. Hence H4 is accepted.

Both the control and the experimental group have shown a significant variation in terms of cognitive achievement in pretest and posttest. The cognitive achievement has increased for both control and experimental group in pre and posttest. The higher mean value (21.40) of experimental group in posttest compared to the mean value (17.73) of control group in posttest reveals that the increment in cognitive achievement is comparatively higher for experimental group. Therefore, CAI has a positive impact on the total cognitive achievement.

The above graph also shows the higher cognitive achievement of experimental group compared to control group in posttest. The graph also shows the group which had comparatively lower mean value in the pretest in considered as experimental group and shows a better performance in the posttest.

MAJOR FINDINGS

The response of students to CAI has been overwhelmingly positive. ‘t’ tests for comparison of pre and post-test means have revealed that CAI has in every case led to increased achievement. On the basis of data analysis, the following findings are obtained from the study.
1. The result of present study reveals that the cognitive achievement in the topic current electricity for both the experimental and control group is almost same in the pre test.
2. The result of the present study clearly points out the significant increase in the mean scores that has been found in the post test scores of the experimental group.
3. The study points out the positive impact of CAI on total cognitive achievement in post test of experimental group.
4. It is found from the study that the experimental group whose mean score was slightly less than control group in pretest has possessed sufficiently higher mean score in posttest.

CONCLUSION

The present study has established that CAI significantly improves the performance and learning achievements of students in physics. It is evident that the CAI is an effective media of instruction of teaching physics than traditional method at higher secondary level to achieve different objectives of cognitive domain. In present time the computer education has been introduced at the school level. The teacher should use computer as a media of instruction in class room. CAI can be arranged to be presented in large class room as it provides maximum amount variety and flexibility by maintaining the quality and quantity of education.

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