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Effectiveness of teaching physics through computer assisted instruction and traditional method 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 emphasison the individualized methods of instructions. 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 teaching Physics at Higher Secondary level. The experiment was carried out on the students of class XI 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 achievement of learner in teaching Physics at Posttest stage.

Keywords: computer assisted instruction, traditional method, physics teaching, experimental group, control group

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. However, 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 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) [23], Price (1989), Roberts and Madhere (1990), Rha and Bedell (1998), Hsiao (2001) and Raninga (2010) [22] 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 did.

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); ÇekbagÕ *et al*., (2003); Yenice, (2003); Carter, (2004); Moodly, (2004); Preciado, (2004); Brooks, (2005); Bryan, (2006); Çepni *et al*., (2006); Wilder, (2006); Liao, (2007) have performed a lots of work on the effectiveness of CAI and found its positive impact on teaching learning process. Tambade and GobjiWagh (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 Classroom 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 Arithmatic. 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 CA 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.

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) [5] 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.

Finkesteinet. *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 this 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 physics at higher secondary level than traditional method of instruction.

Materials and Methods

The use of computer technology to supplement traditional instruction to develop concept of physics 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 this 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 physics or is traditional instruction more effective for these students? Do students be able to form consistent conceptual understanding in physics?

Objectives of the study

The objectives are to compare the learning effects of two groups of learners studying the same Physics curriculum. One group is taught through traditional method and the other group is taught using CAI format instruction. The objectives are-

1. To develop computer assisted instructional package on the topic Newton laws of Motion and Scalars and Vectors of Physics curriculum.
2. To compare the mean scores related to the achievement of the control group and experimental group in their pretest.
3. To study whether there is significant difference in the scores related to the achievement of pretest and posttest of the control group.
4. To find out whether there is significant difference in the scores related to the achievement of pretest and posttest of the experimental group.
5. To compare the scores related to the achievement obtained by the control group and experimental group in their posttest.

Hypothesis

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

- There is no significant difference between the mean scores related to achievement of experimental and control group in the pretest.
- There exist no significant difference between the mean

scores related to achievement of pretest and posttest of the control group.
- There is a significant difference between the pretest and posttest gain scores of achievement of the experimental group.
- There is a significant difference between the posttest scores of achievement of control group and experimental group.

Limitations and Delimitations
1. This study has not examined alternatives of CAI such as internet or distance learning.
2. Computer use is limited to the presentation of curriculum only.
3. The higher secondary schools under Tripura board of secondary education are selected for the research work.
4. The subjects of the study are limited to higher secondary level Physics only.
5. 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.
6. Learners use Bengali/English as an instructional medium.

Methodology
This part of the paper deals with the details about sampling technique and data collecting tools to be used to carry out the study.

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 is the Pre-test - Posttest Equivalent groups Deign.

Sampling and Tools
All students of Physics at higher secondary level from all higher secondary schools of Tripura are the population of this study. However, the researcher has taken the student from one school especially class XI students under Tripura Board of Secondary education as the sample of the study i.e. total 60 students are selected through random sampling method for the said study. The sample was divided into two groups namely Experimental and Control group. The experimental group was taught Newton's laws of motion and Scalar-vectors of Physics curriculum by computer assisted instruction and the control group was taught the same part by traditional method of teaching. The independent variable is the mode of instruction, and the dependent variable will be the achievement of students as measured by the posttest.

Construction of Tools
The investigator constructed an achievement test in physics on the topic of Newton's laws of motion and scalars-vectors. 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 from0.35 to. 50 was considered the appropriate. The reliability was established by the split half method and 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 was used in pretest as well as in posttest.

Development of CAI
The contents were taken from the XI th standard of state board on physics. The computer assisted instruction materials were developed by dividing the whole content into different tasks, which were presented in the form of Microsoft power point. Question was also there to test the understanding and learning of the students. Appropriate background, coloring and pictures were used to make the instruction more interesting.

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. The CAI format lessons were installed 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. The experimental group was exposed to CAI and the control group was instructed by the traditional method of teaching.

Data Collection
At the end of teaching by CAI and by traditional method, a posttest was administered to all the students of both groups. Data were collected from both the groups by giving them a test consisted of 25 items, which will focus the achievement of students

Results
The following findings are obtained from the study-
1. The result of present study reveals that both the experimental and control group has nearly the same score in the pretest.
2. The result of the present study clearly point out the significant increase in the mean scores that has been found in the posttest scores of the experimental group.
3. Significant differences have been found between the control and experimental group on posttest scores.
4. The experimental group, which was taught by CAI, showed better learning.
5. It is evident that the CAI is an effective media of instruction of teaching physics than traditional method at higher secondary level.

Discussion
Statistical techniques serve the fundamental purpose of the description and inferential analysis. Collected data are analyzed in terms of mean scores and standard deviation. To find the significance of the difference between pre and posttest scores t-test was applied. The results obtained in the experiment were tabulated and have been presented in the form of table and discussed below.

Table 1: Experimental and control group in the pretest

Group	N	Mean	S.D	t-Value	Level of Significance
Experimental	30	12.06	1.74	1.41	Not significant
Control	30	12.76	2.07		

The above table reveals that the mean achievement score in the pre test are 12.06 and 12.76 for experimental and control group respectively. The 't' value is 1.41, which is not significant at 0.05 level. Hence it can be concluded that there is no significant difference between experimental and control group in the pretest achievement. Both the group has nearly the same score in the pretest. Hence, the first null hypothesis has been accepted.

Table 2: Control group in the pre and posttest

Group	N	Mean	S.D	t-Value	Level of Significance
Pre test	30	12.76	2.07	0.75	Not significant
Post test	30	12.3	2.65		

The above table shows that the mean scores obtained by control group in pre and post test are 12.76 and 12.30 respectively. The t-value is calculated as 0.75, which is not significant at 0.05 level of significance. Control group has showed no significant change in their achievement scores in pre and posttest. Hence, the second hypothesis is accepted.

Table 3: Experimental group in the pre and posttest

Group	N	Mean	S.D	t-Value	Level of Significance
Pretest	30	12.06	1.74	11.07	Significant
Posttest	30	18.26	2.51		

The above table shows that the mean scores obtained by experimental group in pre and posttest are 12.06 and 18.26 respectively. The t-value is 11.07, which is statistically significant at 0.05 level of significance. Hence, it can be safely concluded that experimental group has achieved significantly higher score in the posttest. This evidently shows the positive impact of CAI on achievement of students. Hence, the third hypothesis is accepted.

Table 4: Experimental and control group in the posttest

Group	N	Mean	S.D	t-Value	Level of Significance
Experimental	30	18.26	2.51	9.03	Significant
Control	30	12.30	2.65		

The table shows the mean scores of the experimental and control group are 18.26 and 12.30 respectively in the posttest. The t-value is 9.03, which is significant at 0.05 levels. Hence it is interpreted that the experimental and control group differ significantly in the posttest and the difference is in favor of experimental group. Conclusion is evident that the students who are taught by the computer-assisted instruction learned more and so higher achievement is obtained than the traditional method of teaching. This is due to the favorable impact of CAI on achievement of the students. Hence, the fourth hypothesis of the study is accepted.

Conclusion

This paper has specially emphasized on computer literacy. The entry of computers in the classroom has changed the entire scenario. The computer is now regarded as the super-teaching machine. Its use in education has been tried as an innovation and it has proved its teaching efficiency in different subject areas. The present study has established that CAI significantly improves the performance and learning achievements of students in physics. In present time, the computer education has been introduced at the school level. The teacher should use computer as a media of instruction in classroom. CAI can be arranged to be presented in large classroom as it provides maximum amount variety and flexibility by maintaining the quality and quantity of education.

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