

EFFECTIVENESS OF CAI PACKAGE ON ACHIEVEMENT IN PHYSICS OF IX STANDARD STUDENTS

By

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ABSTRACT

The present study is an experimental one in nature, to find out the effectiveness of CAI package on Achievement in Physics of IX std. students. For this purpose a CAI package was developed and validated. The validated CAI package formed an independent variable of this study. The dependent variable is students' achievements in physics content. In order to find out the achievements in Physics among IX standard students, the investigator developed and standardized an achievement test on Physics unit entitled "Work, Power and Energy" prescribed for IX std. by Tamilnadu Textbook Society. It is a pre-test-post-test equivalent group design. In order to have randomization in the sample the investigator selected two schools in Madurai city. The Experimental and Control groups were identified in both these schools. Before the treatment both experimental and control groups were equated based on their performances in entry level test. The selected experimental and control groups were administered Pre test, developed and validated by the investigator. The treatment was conducted in four equal sessions. After all the treatments both the groups were administered Post test. Data were collected from the students. They were tabulated and statistical treatments were applied. The analysis results are discussed in this paper.

Keywords: Effectiveness, Achievement, CAI, IX standard students, Physics Achievement, CAL, CBI.

INTRODUCTION

Computers are being increasingly employed for classroom instruction as also for individualized and distance education. Computer Based Instruction (CBI) is also known as Computer Aided Learning (CAL) in the United Kingdom and Computer Assisted Instruction (CAI) in the United States of America. These refer to online direct interactive learning experience through the computer. It can be done in one of the many different modes of instruction, some of which are Tutorial Mode, Drill & Practice Mode, Simulation Mode, Discovery Mode and Gaming Mode (Kumar, K. L., 1986, Geisert, P. G. and Futrell, M. K. 1995). The CAI is an innovative step in this direction towards automation and individualization of instruction. The learning of Physics can be made effective by means of CAI package.

Need for the Study

Since antiquity, human beings have sought to understand the working of nature; Why unsupported objects drop to the ground?; why different materials have different properties?;

the character of the universe such as the form of the Earth and the behavior of celestial objects such as the Sun and the Moon, and so forth. Typically, the behavior and nature of the world were explained as the actions of gods. Eventually, explanations were proposed based on philosophical speculation. Rarely verified by systematic experimental testing, many of them were wrong, but this is part of the dialectical nature of scientific enquiry, and even modern theories of quantum mechanics and relativity are merely considered "theories that have not been broken yet".

The growth of physics has brought not only fundamental changes in ideas about the material world, mathematics and philosophy, but also through technology, a transformation exists for society. Physics is considered both a body of knowledge and the practice that makes and transmits it. The Scientific Revolution, beginning about year 1543, is a convenient boundary between ancient thought and classical physics. The emergence of physics as a

science distinct from natural philosophy began with the scientific revolution of the 16th and 17th centuries, and continued through the dawn of modern physics in the early 20th century. The year 1900 marks the beginning of a more modern physics. Today, the science shows no sign of completion, as more issues are raised, with questions rising from the age of the Universe, to the nature of the vacuum, to the ultimate nature of the properties of subatomic particles. Partial theories are currently the best that physics has to offer, at the present time. The list of unsolved problems in physics is large. (http://www.cs.mcgill.ca/~rwest/link-suggestion/wpcd_2008-09_augmented/wp/h/History_of_physics.htm)

Today, physics is responsible for automation in many industries. Its principles are having universal applications. Its understanding will help the children learn the scientific concepts in reality. It is an essential subject for all human beings. (Richard Sorabji, 2006) Physics at high school level is an important one as these form the base for the future applications in science, engineering and other related fields. Automation in learning physics will be useful for children to understand the concepts of physics. Learning Physics concepts through CAI will be an interesting and meaningful learning experience for children. So, the present study is an attempt to find out the effectiveness of CAI on Physics achievement of IX standard students in Madurai City.

Background of the Problem

The present era is undergoing a revolution in the field of Education. To meet the great demands of mass education, it is important to introduce new techniques of learning, and to provide reliable instructional material based upon the findings of Educational Technology.

Technology or Automation is a major solution to the challenge posed by "Knowledge explosion" and "Population explosion" (Mahender Reddy Sarsani, 2006). The CAI is an innovative step in this direction towards automation and individualization of instruction. Several attempts have been made in the form of research studies in this field.

The learning of Physics can be made effective by means of CAI package. (<http://shodhganga.inflibnet.ac.in:8080/>

[jspui/bitstream/10603/2517/8/08_chapter%201.pdf](http://shodhganga.inflibnet.ac.in:8080/jspui/bitstream/10603/2517/8/08_chapter%201.pdf)) It will certainly augment the teaching learning process of Physics. It would be interesting to the students.

Literature Review

Review of relative Literature indicates that CAI packages have been prepared in various disciplines. Panda, Subhash Chandra & Chaudhury, Jaya Krishna (2000) have conducted a study on "Effect of Computer Assisted Learning (CAL) in achieving Higher Cognitive skills". The objectives of the study were (i) To determine the degree of attainment of cognitive skills through CAI compared to traditional approach to teaching and (ii) To compare the effect of CAI on the learning achievement of boys and girls. The findings revealed that (i) CAL resulted in greater learning achievements in all hierarchies of cognitive domain. (ii) Male students were found to be superior to female students in learning physics. Kadiravan.S & Balasubramanian.N., (2005) have conducted a study on "Development and Validation of Computer Tutorials". The authors explain that the success and development of Computer Assisted Instruction largely depends upon three components viz., Instructional Strategy, Screen Design and Human factors. By designing curriculum courseware based around these three components, educators can translate new technological development into teaching-learning process. This curriculum based design approach enables educators to organize, develop and implement effective learning tools. Hence, a great deal of attention and caution is required while selecting and evaluating the CAI packages. The teachers and courseware designers must infuse curriculum – based learning packages to promote the learning of students. Moreover, the computer tutorials have widespread application in the field of education and therefore their development and validation are of paramount importance in the changing times.

A survey of the relative literature shows that, many studies have been done in the field of Science and in Physics. They reveal that, there has been significant positive effect in achievement through CAI package than the traditional method (Sindhi, N. O. 1996). Hence, it is an attempt to give testimony to it.

Terms and Definitions

Effectiveness: It refers to the result of independent variable introduced in the study.

CAI Package: refers to Computer Assisted Instruction Package developed and validated on physics Unit i.e. Work, Power and Energy for IX std. students of Tamilnadu State Board Syllabus.

Physics Achievement: refers to achievement in criterion referenced test prepared and validated on Physics unit "Work, Power and Energy" of IX std. in Tamilnadu State Board Syllabus by the Investigator.

IX Standard Students: refers to IX std. of 10+2+3 system of Education pattern.

Objectives of the Study

The Study has been attempted with the following objectives;

1. To develop a CAI package on Physics unit Work, Power and Energy for IX std. students of Tamil Nadu State board Syllabus
2. To validate the CAI package on Physics unit Work, Power and Energy for IX std. students of Tamil Nadu State board Syllabus
3. To prepare a criterion test on Physics unit Work, Power and Energy for IX std. students of Tamil Nadu State board Syllabus
4. To validate the criterion test on Physics unit Work, Power and Energy for IX std. students of Tamil Nadu State board Syllabus
5. To find out the effectiveness of CAI package on Physics achievement of IX std. students.
6. To find out the effectiveness of CAI Package on Physics Achievement of IX std. students in terms of various sub groups of the sample selected for the study.

Hypotheses Formulated for the Study

The investigator has formulated the following hypothesis for the study.

1. There is no significant difference between the mean scores on Criterion Test "Work, Power and Energy" (post test) between experimental and control group students of IX standard.

2. There is no significant difference between the mean scores on Criterion Test "Work, Power and Energy" (post test) between experimental and control group boys of IX standard.
3. There is no significant difference between the mean scores on Criterion Test "Work, Power and Energy" (post test) between experimental and control group girls of IX standard.

Methodology

Design of the Study

A worthwhile research project is likely to result from a well formulated research design (Best, J.W. 2009). The design can be equated to a blue print which provides a clear cut guideline to the investigator in carrying out his/her research successfully. In the present study, the investigator developed and validated CAI package on Physics unit Work, Power and Energy. To achieve the objectives the investigator has chosen a pretest & post test equivalent groups design. The Schematic presentation of the design for the present study is given in Table 1.

Variables Under the Study

The variables under the study are (1) Independent Variables namely, "Learning the unit Work, Power and Energy through CAI package - Experimental Group" and "Learning the unit through Work, Power and Energy through Traditional Teaching method - Control Group". (2) Dependent Variable – "Criterion in Work, Power and Energy" and (3) Covariates - Pre-test scores.

Preparation of Criterion Test on Work, Power and Energy (CTWPE)

The investigator prepared a criterion test to assess the effectiveness of CAI package on Learning Physics unit for IX std. students. It is a criterion referenced test. Criterion Test is used to measure the instructional objectives of the programme. Generally, objective test items are used in a criterion test.

The investigator has identified Work, Power and Energy as the unit for testing the effectiveness of CAI package on Physics achievement of IX std. students. Therefore the investigator has taken the teaching points identified for the CAI package as the criteria for the achievement test on

Physics.

Construction of Test Items

The investigator after identifying items as for the criterion test

It is a pretest –post test equivalent groups design

I Variables Under The Study

1.Independent Variable	1. Learning the unit Work, Power and Energy through CAI package - Experimental Group
	2. Learning the unit through Work, Power and Energy through Traditional Teaching method - Control Group
2. Dependent Variable	1. Criterion in Work, Power and Energy
3. Covariates	Pre-test scores

The above variables are studied under gender and parental wise sub groups

II Tools Used

Name of the Tool	Purpose
1. Achievement Test on Work, Power and Energy	To measure the achievement of the IX std. students in the unit Work, Power and Energy
2. Embedded Tests	To measure the progressive Achievement of students in the unit Work, Power and Energy
3.Stimulus Materials Used CAI Package on "Work, Power and Energy"	As the treatment variable

III Samples Selected

a) For the Development of CTWPE	Purpose
1. Two college physics lecturers and four practicing teachers	Getting ideas, concepts for drafting CTWPE
2. Twenty IX std. students from section A of Thiagarajar Model Hr.Sec. School.	For doing item analysis of CTWPE
3. Twenty IX std. students from section B of Thiagarajar Model Hr.Sec. School.	For establishing reliability and validity of CTWPE
b) for the Development of CAI Package	Purpose
1. Two college physics lecturers and four practicing teachers	For Getting ideas regarding construction of frames for CAI
2. Two Computer Teachers from E.V.R.Corporation Girls Hr. Sec. School	For validating the CAI package
3. Four IX std. students from section C of Thiagarajar Model Hr.Sec. School	For Trying out the CAI package
c) for conducting Experiment	

Group	No. of Students			School
	Boys	Girls	Total	
Experimental I (CAI Package)	20	20	40	1.Thiagarajar Model Hr.Sec. School
				2.E.V.R.Corporation Girls Hr.Sec. School
Control Group	20	20	40	1.Thiagarajar Model Hr.Sec. School
				2.E.V.R.Corporation Girls Hr.Sec. School

IV Collection of Data

Data were collected from the identified students using CTWPE before and after the treatments.

V Statistical Techniques Used

Measures of central tendencies, measures of variability, coefficient correlation, Spearman Brown Prophecy Formula, t-test, ANOVA, ANCOVA and product moment correlation were applied to the data.

Table 1. Schematic Presentation of Research Design

on work, power and energy started constructing items for the CTWPE. Table 2 shows the no. of Questions Attempted on Each Item.

Preparation of Weightage Tables for Preliminary Draft of CTWPE

The investigator prepared weightage tables as content wise and objective wise. They are presented in Table 3&4.

Preparation of Blue Print

The investigator after preparing the weightage tables, prepared a blue print for the preliminary draft of CTWPE. They are given in the following Table 5.

Scoring Key

The investigator prepared scoring keys for all tests viz. (1) Entry Behavior test, (2) CTWPE which was used as pre and post test and (3) Embedded tests.

Item Analysis of CTWPE

Item analysis is done in order to improve the reliability and

S.No	Concepts	No of questions taken	Question Nos
1	Work	4	1 to 4
2	Unit of Work	3	5 to 7
3	Measurement of Work	1	8
4	Displacement in the direction of force.	2	9,10
5	Displacement perpendicular to the Direction of the force.	3	52, 53, 58
6	Work is a Scalar Quantity.	1	11
7	Power	7	12 to 16, 54,55
8	Energy	4	17 to 20
9	Potential Energy	4	21,22,56,57
10	Kinetic Energy	1	23
11	Law of Conservation of energy	3	24, 59, 60
12	Verification of law of conservation of energy for a freely falling body	1	25
13	Transformation of energy	4	26 to 29
14	Sources of energy	1	30
15	Sun is the main source of energy	2	31,32
16	Hydro energy	1	33
17	Solar energy	3	34 to 36
18	Geothermal energy	1	37
19	Wind energy	2	38,39
20	Tidal energy	1	40
21	Bio-energy	1	41
22	Nuclear Energy	6	42 to 47
23	Non -renewable sources of energy.	2	48, 49
24	The power requirement in India.	1	50
25	Judicious use of energy	1	51

Table 2. Showing Number of Questions Attempted on Each Item.

validity of the test. In item analysis, the difficulty level and discriminative index of the test items were found by administering the selected students. The investigator first fixed up a difficulty level of 30-90 and discriminative value of 0.30 and above for the selection of items for the final draft of CTWPE. Based on this 25 items were selected. There were 35 items eliminated just because of having less difficulty level and discriminative index. Considering the number of items rejected, the investigator carefully analyzed again each items left out. The investigator after item analysis, prepared weightage tables for the final draft of CTWPE and found reliability by conducting test retest method.

Data Collection for Pre - Test & Post - Test

Being an experimental study the data had to be generated, unlike the survey. It is a pre-test to post-test control group design that was planned to achieve the objectives of the study. In this attempt, students from two different schools were selected. They were randomly assigned to different treatments (i) Experimental – learning through CAI package and (ii) Control group – traditional way of learning. The sample selected for conducting the experiment is presented under Table 1.

S.No	Sub Units	Marks (60)	Percentage
1	Work	14	23
2	Power	7	12
3	Energy	17	28
4	Sources of Energy	22	37

Table 3. Weightage to Content of the Preliminary Draft of CTWPE

S.No	Objectives	Marks (60)	Percentage
1	Knowledge	26	43
2	Understanding	19	32
3	Application	15	25

Table 4. Weightage to Objectives of the Preliminary Draft of CTWPE

S.No	Content / Objectives	Knowledge	Understanding	Application	Total
1	Work	(1) ⁷	(1) ²	(1) ³	(1) ¹⁴
2	Power	(1) ³	(1) ²	(1) ²	(1) ⁷
3	Energy	(1) ²	(1) ⁸	(1) ⁷	(1) ¹⁷
4	Sources of Energy	(1) ¹²	(1) ⁷	(1) ³	(1) ²²
	Subunit Total	(1) ²⁶	(1) ¹⁹	(1) ¹⁵	(1) ⁶⁰

Table 5. Blue Print of the Preliminary Draft of CTWPE

Data Analysis

The investigator applied 't' tests between experimental and control groups for the post test scores of Criterion Test on Work, Power and Energy.

Hypothesis 1

There is no significant difference between the mean scores on Criterion Test Work, Power and Energy (post test) between experimental and control group students of IX standard.

Table 6 presents the 't' tests results on the criterion test on work, power and Energy (post-test) between experimental and control groups.

It is evident from Table 6 that the 't' value between the experimental and control groups' students in their mean achievement on Criterion Test Work, Power and Energy is 4.695. It is significant at 0.01 and 0.05 level for the DF 78. The mean of Experimental group (69) is higher than the mean of control group (58). Therefore the null hypothesis stated is rejected. It can be inferred that the CAI Package on Work, Power and Energy has effected the students' achievement in physics concepts.

Hypothesis 2

There is no significant difference between the mean scores on Criterion Test Work, Power and Energy (post test) between experimental and control group boys of IX standard.

Table 7 presents the 't' tests results on the Criterion Test on Work, Power and Energy (post-test) between experimental and control group boys.

It is evident from Table 7 that, the 't' value between the experimental and control groups' boys in their mean achievement on Criterion Test Work, Power and Energy is 3.170. It is significant at 0.01 and 0.05 level for the df 38. The mean of Experimental group (77) is higher than the mean of control group (64). Therefore the null hypothesis stated is rejected. It can be inferred that the CAI Package on Work, Power and Energy has effected the boys' achievement in

Sl.No.	Group	N	MEAN	S.D.	't'	DF	Level of Significance
1.	Experimental	40	69	10.96	4.695	78	0.01
2.	Control	40	58	10.56			

Table 6. Significance of Difference of Mean Achievement on Criterion Test Work, Power and Energy (post Test) Between Experimental and Control Groups

physics concepts.

Hypothesis 3

There is no significant difference between the mean scores on Criterion Test Work, Power and Energy (post test) between experimental and control group girls of IX standard.

Table 8 presents the 't' tests results on the Criterion Test on Work, Power and Energy (post-test) between experimental and control group girls.

It is evident from Table 8 that, the 't' value between the experimental and control groups' girls in their mean achievement on Criterion Test Work, Power and Energy is 2.567. It is significant at 0.05 level only for the df 38. The mean of Experimental group (62) is higher than the mean of control group (52). Therefore the null hypothesis stated is rejected. It can be inferred that the CAI Package on Work, Power and Energy has effected the girls' achievement in physics concepts.

Findings of the Study

1. The CAI package on Physics unit Wind, Power and Energy for IX std. Students of Tamil Nadu State board Syllabus was developed and validated.
2. The Criterion Test on Physics unit Wind, Power and Energy for IX std. Students of Tamil Nadu State board Syllabus was prepared and validated.
3. The developed CAI Package on Work, Power and Energy has effected positive changes ('t' value = 4.695 which is significant at 0.01 level) in the IX std. students' achievement in physics concepts.
4. The CAI Package on Work, Power and Energy has effected positive changes in the boys' achievement ('t' value is 3.170, which is significant at 0.05 level) in physics concepts.

Sl. No.	Group	N	MEAN	S.D.	't'	DF	Level of Significance
1.	Experimental	20	77	8.26			
2.	Control	20	64	9.78	3.170	38	0.01

Table 7. Significance of Difference of Mean Achievement on Criterion Test on Work, Power and Energy (post Test) Between Experimental and Control Groups-boys

Sl.No.	Group	N	MEAN	S.D.	't'	DF	Level of Significance
1	Experimental	20	62	7.72			
2	Control	20	52	8.19	2.567	38	0.05

Table 8. Significance of Difference of Mean Achievement on Criterion Test on Work, Power and Energy (post Test) Between Experimental and Control Groups-girls

value is 3.170, which is significant at 0.05 level) in physics concepts.

5. The CAI Package on Work, Power and Energy has effected positive changes in the girls' achievement ('t' value is 2.567 which is significant at 0.05 level) in physics concepts.

Conclusion & Recommendations

It has been found out that, the CAI Package on Physics concept Work, Power and Energy is effective in imparting physics concepts among IX std. students. This study found that CAI packages are successful in imparting content knowledge to students. The boys and girls of IX standard have shown positive responses to CAI package on Work, Power and Energy. So irrespective of sex CAI package was found to be effective in learning physics concepts. CAI packages on various topics of science can be prepared and given to students. The students' interest in CAI package should be sustained by the teachers by preparing CAI package on various subjects. The students of literate parents and parents with degree qualifications have improved upon by CAI package on physics concept Work, Power and Energy. The CAI packages have shown effectiveness among these sections of students. Hence more number of packages on various school subjects can be prepared and given to them. The students of poor parents have shown improvement in learning physics concept Work, Power and Energy through CAI package. The schools should come forward to provide CAI packages on various school subjects in computer labs of schools. Apart from this they should also allocate more time for computer periods. The head of the Institution should insist the teachers to prepare CAI package. Government should allot funds for buying computers in the schools. Proper computer lab should be maintained in the schools.

Limitations and Delimitations of the Study

The study was confined only to the CAI package developed and validated on Physics unit of IX std. syllabus of Tamil Nadu Textbook Society on the unit Work Power and Energy. The study was taken only for IX standard students following Tamil Nadu State Board Syllabus.

The experiment was conducted only in the urban centre.

Rural area students have not been included in the study. The IX std. Matriculation, CBSE, ICSE and other streams have not been taken into consideration for the present study. The study was conducted only with English medium students of IX standard syllabus of Tamil Nadu Textbook Society. The Tamil medium students of IX standard students were not taken into consideration for this study. CAI cannot be prepared for all the chapters in the IX syllabus. All the students cannot study with this method since they need computer in their home as well as in their school. It is time consuming for low achievers. These are the limitations and delimitations of the study.

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