CHAPTER-VI

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6.1.0 INTRODUCTION

“The competitiveness is powered by knowledge power. Knowledge power is powered by innovation. Innovation is powered by science and technology and technology is powered by resource investment”- Dr. A. P. J. Abdul Kalam

Education is the only mean through which a society adjusts with its needs. Therefore, a society can never exist without education. Through education, the members of a society learn the skills to enrich, transmit and transform cultural heritage as well as existing social and scientific knowledge for the continuous advancement of the society. Teaching learning process has been inseparable to human being since ancient times. Leaders of human thoughts have endorsed memorable words about education, knowledge and learning. An educational system is explicitly based on the quest, what to teach and how to teach. “What to teach” means the learning material. The continuum of learning material swings from linguistic to scientific knowledge. The choice of contents and subject from the multifarious branches of knowledge is subjected to social needs.

Science occupies a unique position in the school curriculum. Biology is central to many science related courses such as medicine, pharmacy, agriculture, nursing, biochemistry and so on. It is obvious that no student intending to study these disciplines can do without biology. These factors, among others, have drawn attention of researchers and curriculum planners towards biology as a subject in the school curriculum. In spite of the importance and popularity of biology among students, performance at senior secondary school level had been poor.

The Information and Communication Technologies (ICT) is an umbrella term that includes many communication devices or applications, encompassing: radio, television, cellular phone, computer, and network hardware and software, satellite system and so on. When such technologies are used for educational purposes, namely to support and improve the learning of students and to develop learning environments, ICT
can be considered as a subfield of Educational Technology. Computers are being increasingly employed for classroom instructions as well as for individualized and distance education. It can be used in any mode of instruction. Self learning, using Computer Assisted Instruction (CAI) module is one of them. Computer aided instruction modules are effective for many reasons. One of the most important reasons is that students like learning in the environment that the computer has to offer. Such packages which are product of ICT are much more user friendly and entertaining than their predecessors. These technologies move us light years beyond the tedious drill that early educational software promoted, and allowed highly engaging activities like multimedia simulation. Students can now work at their own pace regardless of the level at which they are supposed to be. This promotes self-confidence because it gives the student a feeling of control over what they are learning. The computer has allowed the student to become a more active participant in his/her education.

6.2.0 OPERATIONAL DEFINITION

Operational Definition of the terms used:-

Development: To construct

Validation of Computer Assisted Instruction module: Validation of CAI module was done in two ways

- By taking expert’s views using ‘CAI module assessment tool’ (developed by the investigator).
- Another criterion for validation of module used was 90/90 criterion i.e. if at least 90% students scored 90% or more. To achieve this criterion required improvements were made in the module.

Biology: Study of living organisms.

Computer assisted instruction: Instructions provided with the help of computer using multimedia approach, for self learning.
6.3.0 COMPUTER ASSISTED INSTRUCTION

Historically, computer-aided instruction, which is also called computer assisted instruction (CAI), has roots in Pressey’s 1925 multiple choice machine and the punch-board device, which foreshadowed the network-supported tutorials of today. Pressey’s multiple choice machine presented instruction, tested the user, waited for an answer, provided immediate feedback, and recorded each attempt as data. In 1950, Crowder developed a process for the U.S. Air Force in which a CAI program presented some content as text, tested the user, provided some feedback, and then branched to corrective instruction or new information based on supplied responses. Branching was thought to be an advance on Pressey’s multiple-choice machine. In 1954 at the University of Pittsburgh, Psychologist B. F. Skinner demonstrated a teaching machine for “reinforcing,” not just teaching, spelling and arithmetic with a machine. The user may access auditory material, listen to a passage as often as necessary then transcribe it. The machine then reveals the correct text. He may listen to the passage again to discover the sources of any error.

Developers applied principles of data transmission and reinforcement theory to a variety of educational situations. Skinner used reinforcement theory to downplay the role of punishment in changing the behaviour. Instead, he was convinced that behaviour could be altered by simply using positive and negative types of reinforcement. Positive reinforcers presented rewards (good grade or congratulatory comment) after the user achieved a desired behaviour. Negative reinforcers remove aversive stimuli after the user failed to achieve a desired behaviour. Crowder applied these ideas to “intrinsic programming” so that a user’s responses determined the material to be presented next. The main advantage of intrinsic programming was that it did not waste the time of the fast learner with unnecessary repetition. Its disadvantage was that it required a large amount of content to present even a relatively small amount of material. Later, CAI researchers observed that algorithms for teaching with CAI had to incorporate both the physical programming or authoring to run the computer program and the instructional programming required to learn from the program. Presently different types of CAI are available-
1. Tutorial mode
2. Drill and practice mode
3. Simulation mode
4. Discovery mode
5. Gaming mode

In the present study, developed module is of tutorial mode. Computer-aided instruction packages are effective for many reasons. One of the most important reasons is that students like learning in the environment that the computer has to offer. Such packages which are product of ICT are much more user friendly and entertaining than their predecessors. Students can now work at their own pace regardless of the level at which they are supposed to be. This promotes self-confidence because it gives the student a feeling of control over what they are learning. The computer has allowed the student to become a more active participant in his/her education.

Modular approach is an attempt to make the instruction individualized so that the student may learn at his own pace according to his interest, capabilities and capacities.

6.4.0 NEED OF THE STUDY

Researchers have employed varying research methods in an attempt to understand the role that computer technology can and does play in the education of children. Consequently, there are a number of differing lines of research that have been conducted, and many of the lines of inquiry may overlap with others. This has resulted in a large amount of research, but so varied in method and treatment that at times is difficult to categorize. There are areas for which there is little, if any, information available, meaning that there is much that we do not yet know about the effects of this technology on student learning. Because there are a variety of ways in which technology has been used in the past and a variety of ways it is being used today in education. It is important to consider each line of research individually in an attempt to sort out the status of what is known and what research is yet to teach us.

Educational technology offers solution to many problems of modern educational system. To tackle one of these problem in form of ‘individual differences’ among
students self instructional material/module or multimedia package is one of the best solution. The use of multimedia in teaching ‘Genetics’ and their integration in the classroom has remained almost completely unexplored. So with the intention of developing module and testing its effectiveness the investigator has selected self instruction module development as the topic for research.

6.5.0 STATEMENT OF THE PROBLEM

DEVELOPMENT AND VALIDATION OF COMPUTER ASSISTED INSTRUCTION MODULE IN LEARNING BIOLOGY

6.6.0 OBJECTIVES OF THE STUDY:

1. To develop computer assisted instruction module in Biology for class XII.
2. To assess the validation of computer assisted instruction module.
3. To compare the achievement of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology.
4. To compare the achievement of the students on the basis of sex with respect to computer assisted instruction and conventional teaching in the subject of Biology.
5. To compare the achievement of the students on the basis of intelligence with respect to computer assisted instruction and conventional teaching in the subject of Biology.
   a. High Intelligence
   b. Average
   c. Below average
5. To compare the achievement of the students on the basis of different learning objectives with respect to computer assisted instruction and conventional teaching in the subject of Biology.
a. Knowledge
b. Comprehension
c. Application

7. To study the users’ reaction towards computer assisted instruction.
8. To compare the retention of the students in Genetics in control and experimental group.

6.7.0 HYPOTHESES OF THE STUDY

1. There is no significant difference in the mean achievement score of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology.

2. There is no significant difference in the mean achievement score of the students on the basis of sex with respect to computer assisted instruction and conventional teaching in the subject of Biology.

3. There is no significant difference in the mean achievement score of the students on the basis of their intelligence level with respect to computer assisted instruction and conventional teaching in the subject of Biology.
   a. High Intelligence
   b. Average
   c. Below average

4. There is no significant difference in the mean achievement score of the students in different learning objectives with respect to computer assisted instruction and conventional teaching in the subject of Biology.
   a. Knowledge
   b. Comprehension
c. Application

5. There is no significant difference in the mean retention score of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology.

6.8.0 METHODOLOGY OF THE STUDY

6.8.1.1 Population-

The population for the present study comprised of XII class students studying in senior secondary schools.

6.8.1.2 Sample

Small representative portion of the population is called sample. Sample was collected from XII class students from following two schools using purposive sampling technique. Then matched randomization technique was used on the bases of intelligence of the students to select the final sample for experimental and control group.

The present study was consisted of a sample of 50 students studying in XII class of-

- Hindu Vidyapeeth, Sonepat
- Shiva Shiksha Sadan Sr. Sec School, Sonepat
6.8.1.3 Procedure of sampling

Out of 83 students of XII grade studying in Biology stream, 25 pairs of equal intellectual capacity were selected and assigned randomly to the experimental and control groups. Paired matching was done on the basis of intellectual capacity scores on G.C. AHUJA Group Intelligence Test, the instrument to measure the intellectual capacity. The test was administered to a total 75 students who were present on the day of administration of the instrument. Scores on GGIT revealed that thirty two percent students were above average, forty percent were average and twenty eight percent were below average. Twenty five pairs of equal intellectual capacity were to be taken as a sample of the study. It was done by taking proportional number of pairs to the percentage of each category i.e. 8 pairs from above average, 10 pairs from average and 7 pairs from below average intelligence group. One subject of each pair was randomly assigned to one group and the other to the second group. A coin was tossed to designate the groups as experimental and control group.

6.8.2 Tools used

In the present study following tools were used for the collection of data:

- Computer Assisted Instruction module on ‘Genetics’. (Developed by investigator)
- Performa for Assessment of Genetics CAI Module by experts (Developed by the investigator)
- G.C. Ahuja Group Test of Intelligence (GGTI) by Dr. G.C. Ahuja
- Achievement test of ‘Genetics’ (Developed by investigator)
- Retention test (Achievement test of ‘Genetics’ was reused as Retention test)
- Reaction Towards Computer Assisted Instruction Scale for students (Developed by investigator)
6.8.2.1 Computer Assisted Instruction Module on ‘Genetics’

Developmental process of the CAI module consisted of two different phases i.e. Pre-development phase and Developmental phase. Each of these phases had a number of stages that were organized sequentially.

I. Pre-development phase

Different stages of this phase were:

- Content analysis of XII class syllabus
- Instructional design

II. Developmental phase

The investigator followed the following ICT plan (steps) for developing the module:

- Development of the program concept with reference to scope.
- Development of outlines of the module.
- Development of logic flowchart.
- Development of the program storyboard.
- Plan of user interface.
- Preparation of scripts for narrations, text and videos.
- Plan for the production of music, audio and video.

6.8.2.2 G. C Ahuja Group Test of Intelligence

Intelligence level of the subjects was assessed using G. C Ahuja Group Test of Intelligence (GGTI) developed by Dr. G. C Ahuja

Format of the test:

There are 135 items in the scale which are distributed in eight sub-tests:

- Following directions
- Classification
- Analogies
• Arithmetic reasoning
• Vocabulary
• Comprehension
• Series
• Best answer

Reliability & Validity:

Reliability of G. C Ahuja Group Test of Intelligence (GGTI) Scale estimated by Split half method which is 0.974±0.003, which is a very high correlation and hence is very dependable.

Validity of GGTI scale is 0.69±0.47.

6.8.2.3 Genetics Achievement Test:

Genetics Achievement Test was developed by researcher to measure the achievement of students in Genetics. Its development comprised of following major steps:

• Formulation of instructional objectives
• Preparation of Test Design
• Preparation of Blue print
• Writing of Questions:
• Preparation of Marking Scheme:
• Test standardization

The final form of the test consisted of sixty items.

6.8.2.4 Reaction Towards CAI Scale for students

Purpose of RTCAIS:

Reaction Towards CAI Scale assesses the usability of the developed CAI module. The aim of usability testing was to identify problem area, and extracting information concerning problems, difficulties, weaknesses and areas for improvement.
Description of RTCAIS:

The scale consists of the following three dimensions according to different weightage given to each:

- Content organization
- Communication and innovation strategy
- Content effectiveness

The method of the assessment of each dimension is based on five point scale. The scale in its final form consists of 25 items.

6.8.2.5 Performa for Assessment of Genetics CAI Module for experts

Purpose:

Purpose of assessment by experts was to assess the applicability/validity of the developed CAI module, to identify problem area, and extracting information concerning problems, difficulties, weaknesses and areas for improvement.

Description:

The scale consists of the following dimensions according to weightage given to each:

- Content
- Organization of the Content
- Language of the content
- Presentation of the content
- Evaluation part of the module

The method of the assessment of each dimension is based on five point scale. The scale in its final form consists of 23 items.
6.9.0 Research Design

In the present study the investigator has employed Two Group, Randomized Matched Subjects, Post-test-only Design. The sample was collected using purposive sampling, then instead of using random assignment of subjects to experimental and control group, a technique of matching was used. The variable selected for matching i.e. intelligence, has a significant correlation with the dependent variable i.e. post-test achievement scores. The subject from desired population was paired so that their scores on matching variable became as close as possible. One subject of each pair was randomly assigned to one group and the other to the second group. A coin was tossed to designate the groups as experimental and control group.

Fig: Experimental research design: Two Groups, Randomized Matched Subjects, Post-test-Only Design.
This Fig can be tabulated as:

**Table: Experimental Research Design**

<table>
<thead>
<tr>
<th>Scientific random assignment of subjects to-</th>
<th>Independent Variable</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group</td>
<td>Computer Aided Instruction</td>
<td>Experimental group’s mean achievement score</td>
</tr>
<tr>
<td>Control group</td>
<td>Traditional Teaching</td>
<td>Control group’s mean achievement score</td>
</tr>
</tbody>
</table>

The mean achievement score of both the groups were computed to test the significance of the observed difference between them.

**6.10.0 Variables**

In this experimental research, following variables have been studied.

*Independent variables:*

The independent variables that were used in the present study are computer aided instruction and traditional teaching. These variables were manipulated to study the effect on achievement. The experimental group was given CAI treatment and control group was taught through traditional teaching.

*Dependent variables:*

The dependent variable or the criterion variable that was used in the study is achievement in Biology

*Intervening variable*

The intervening variable considered in this study were intelligence, nature of school, grade level and subject unit (content).
Control variables:

The control variables taken in the present study were- nature of school, grade level and subject taught. Control employed for each of this is as follows:

Intelligence level- Controlled statistically by Matched randomization
Natures of school- Only C.B.S.E schools were involved for sampling.
Grade level- Class XII was selected for the present study and it was kept constant during the study.
Content- Both the groups were taught the same unit i.e. Genetics of Biology subject.

6.11.0 PROCEDURE USED FOR DATA COLLECTION

The experimental group was treated with modular instructions and the control group was given a treatment of conventional teaching. At the end of the experiment, an achievement test was administered to both the groups and a comparison of the achievement of the students of the two groups was made. The means of the post-test were computed. The t-test was applied to ascertain whether the observed difference is statistically significant. The experimental group students were the administered with ‘Reaction Towards CAI Scale for students’ to know their attitude towards CAI module. After a span of four weeks the two groups were made to undergo retention test to compare the long term effectiveness of computer assisted modular instructions and conventional teaching. In addition to above subject experts were provided with a performa for assessment of genetics CAI module.
6.12.0 STATISTICAL TECHNIQUES USED

The collected data were analyzed with the help of MS Excel 2007 version. Statistical techniques employed for data analysis are shown in the following table.

Table : Statistical techniques employed for data analysis

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Objective</th>
<th>Hypothesis</th>
<th>Applied statistical technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To develop computer assisted instruction module in Biology for class XII.</td>
<td>---</td>
<td>Flash software</td>
</tr>
<tr>
<td>2</td>
<td>To assess the validation of computer assisted instruction module.</td>
<td>---</td>
<td>Content validity by Experts &amp; 90/90 criterion</td>
</tr>
<tr>
<td>3</td>
<td>To compare the achievement of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology.</td>
<td>There is no significant difference in the mean achievement score of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology.</td>
<td>t-value</td>
</tr>
<tr>
<td>4</td>
<td>To compare the achievement of the students on the basis of sex with</td>
<td>There is no significant difference in the mean achievement score of the</td>
<td>t-value</td>
</tr>
<tr>
<td></td>
<td>respect to computer assisted instruction and conventional teaching in the subject of Biology.</td>
<td>students on the basis of sex with respect to computer assisted instruction and conventional teaching in the subject of Biology.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------</td>
<td>---</td>
</tr>
</tbody>
</table>
| 5 | To compare the achievement of the students on the basis of intelligence with respect to computer assisted instruction and conventional teaching in the subject of Biology.  
   -High Intelligence  
   -Average  
   -Below average | There is no significant difference in the mean achievement score of the students on the basis of their intelligence level with respect to computer assisted instruction and conventional teaching in the subject of Biology. | t-value |
| 6 | To compare the achievement of the students on the basis of different learning objectives with respect to computer assisted instruction and conventional teaching in the subject of Biology.  
   -Knowledge  
   -Comprehension  
   -Application | There is no significant difference in the mean achievement score of the students in different learning objectives with respect to computer assisted instruction and conventional teaching in the subject of Biology. | t-value |
| 7 | To study the users’ reaction towards computer assisted | Experimental group students possess favourable reaction | Coefficient of Variation |
8 To compare the retention of the students in Genetics in control and experimental group. There is no significant difference in the mean retention score of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology. t-value

### 6.13.0 MAJOR FINDINGS

In the present study on the basis of discussion the researcher has formed the following conclusions:

- The Computer Assisted Instruction has enhanced the achievement of experimental group students.
- CAI is more beneficial with average intelligence level students than lower ones, which are further followed by high intelligence level students.
- Comparative enhancement in achievement as a result of CAI was found significantly more among girls than boys.
- The Computer Assisted Instruction has enhanced the achievement of experimental group students in the learning objectives of knowledge, comprehension and application.
- Students retain what they have learnt better with CAI than with conventional instruction alone.
- Researcher found that experimental group students have favourable reaction towards various aspects of Computer Assisted Instruction module and hence, towards CAI.

Precisely, it can be said that Computer Assisted Instruction provides greater opportunities for the students to learn. CAI is better than the traditional method of
learning. It brings an enhancement in achievement and provides new multisensory learning experiences.

6.14.0 EDUCATIONAL IMPLICATIONS OF THE STUDY:

Computer seems to be highly promising educational tool, but it is the way computers are used rather than the actual machines themselves that contribute to learning. Researcher is of the opinion that effectiveness of CAI enhanced the learning as demonstrated by the present study, may be attributed to the module used in the experiment and the way it was used. The CAI module used in the study was developed by the researcher as no CAI module was available to serve the purpose. Thus, the technology demonstrated the great impact on the young minds. This research was an attempt to find out an innovative way of teaching biology and to check the effectiveness of CAI. Following are some of the suggested implications of the present study on the basis of the major findings:

For Teachers:

The results will be helpful-

- in selecting the appropriate instruction for better outcomes of teaching learning process.
- in achieving teaching-learning objectives by imparting education through CAI.
- to develop the learning climate for better adjustment of learners.
- to develop CAI for different topics in different subjects.
- in using this kind of package for slow learners, low achievers as per the need.
- in reducing the workload of the teachers.
- in becoming techno-savvy.

For learners:
The results will be helpful-

-in creating awareness towards CAI.

-in developing interest in the subject matter through CAI.

-in reducing the burden of studies on the students.

-in increasing the curiosity towards such packages.

-in enhancing the retention of the learnt content.

For Educational institutions:

The results will be helpful-

-for preparing CAI to enhance the learning of the students.

-for providing facilities to develop CAI.

For Educational Planners:

The results will be helpful-

-for providing computer laboratory facilities in educational institutions to develop CAI.

-for making provision to provide training to the teachers for the development of CAI.
6.15.0 SUGGESTIONS FOR FURTHER STUDY

The present study throws light on a good number of new areas to be studied by the future researchers. The areas and variables which are not covered by this study may be put to test to enlighten the factors associated with the achievement in different subjects. The findings of the present study have some suggestions for the researchers who want to work in this area. So, the researchers may think of the following areas to study further:

- The present study was confined to the class XII only. Similar researches can be carried out on other classes of school education.
- The present study was confined to the subject ‘Biology’. Other subjects can be considered to develop effective CAI modules to enhance learning of the students.
- The content (Unit-Genetics) of the class XII Biology was according to C.B.S.E curriculum. Further, studies can be extended to the content of other boards of school education like I.C.S.E and various state boards.
- Similar experiments can be done with more variables like locale (rural and urban), medium of instruction (regional and national/English) etc.
- The present study was confined to a small sample; it can further be extended with large sample.
- This kind of study may be conducted in the field of special education to enrich the learning of special students.