



EFFECTIVENESS OF COMPUTER AIDED INSTRUCTION ON ACADEMIC ACHIEVEMENT AND RETENTION OF BIOLOGICAL SCIENCE OF SECONDARY SCHOOL STUDENTS OF KASHMIR DIVISION

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Abstract

The present research determines the effectiveness of computer-aided instruction on academic achievement and retention in the biological sciences among secondary school children in the Kashmir division. The sample of the research consisted of 100 10th-class pupils from government schools (ncert) selected randomly. To equalise the students into two groups on the basis of intelligence, Raven's standard progressive metrics (2005) test was used. The two groups were randomly divided into experimental and control groups. A pre-test was administered to both groups before being subjected to experimentation. The experimental group was taught the first chapter of 10th grade biology, that is, LIFE PROCESSES, through computer-aided instruction, and the control group, through the traditional method of teaching for one month. Post tests were administered to both groups. The academic achievement of the students was measured using the criterion reference test developed by the author; a similar test was developed for measuring retention. The means of the scores of academic achievements of the two groups were compared using the test. Similarly, the means of the scores of retention of the two groups were compared. Results indicated that academic achievement and retention are higher in biological science among secondary school children taught through computer-aided instruction than those taught through traditional methods of teaching.

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Introduction

Education being an important part of social development is the only means by which a society fulfils its needs. It is important for the development of an individual and society. In this modern scientific age there are new technologies that help the teachers and learners in transferring information which otherwise was not possible. The greatest contribution of science is the development and distribution of technology and therein the increased uses of computers in every subject like science, mathematics, language. The effect of technology can be seen even in professions such as medicine, engineering, advertising and education. Computer is an instrument rather machine which helps in computing and exploring the knowledge at just one click. The use of computer has helped widely to overcome the limitations of commonly used traditional method of teaching. "Computers play an essential part in a variety of educational settings. To support ICT-based education, the administration now offers good infrastructure, including smart boards, computers, and LCD projectors, through the ICT Infrastructure in Schools (ICT-in-Schools) scheme, which runs from 2007 to 2012 and seems to be part of the XI Five Year Plan. (MHRD (2010).

Children are beginning to see the effects of such a digital world. It pulls up with the rest of the globe quickly and decisively. It is just a significant transition, mostly from the lecture method, which relied on two school textbooks, to the need for technology. The systems are used for very distinct purposes. The pupils are subjected to cutting-edge technologies while also being taught a unique and rational way of studying, "says the professor (Agarwal. [3]).

Now days, computers are utilized not only in numeric but also in non-numeric applications. Technology has turned to be most important changing agent of the culture. It has brought many innovations which include audiovisual devices, movies and filmstrips etc. which can be used for educational settings. It is making children more attentive, confident and providing them an individualized learning environment. When the National Policy on Education (NPE) 1986 was written, it stressed the importance of digital learning in its efforts to improve teaching and learning. "Computer systems have evolved into significant and omnipresent instruments; a

minimum amount of experience with computer systems, as well as training in related usage, will be required as part of a formal education curriculum. Today, computer technology in schools is one of the fast growing developments. In order to broaden and expand the educational relationship between those being taught, technology could be employed in the classroom. The best innovation in the field of Education is Computer-Aided Instruction (CAI) that helps to conduct different activities of self-learning in order to increase the student's interest in studies.

Problems in Teaching of Biological Science. Biology is the branch of science which deals with the study of living organisms that is plants, animals and microorganism. Now a day it has given rise to different fields like zoology, botany, biotechnology, microbiology, cytology etc. The knowledge of biology is an essential component in medicines, horticulture, agriculture, sericulture, animal husbandry, forestry, engineering etc. so, it is essential for everyone to acquire the knowledge of biology that is why it is an essential subject up to 10th class and optional beyond that. Most of the concepts in biology are abstract, microscopic and complex which students are unable to visualise hence very difficult to explain. Teachers have to work very hard in explaining them to the students through charts, diagrams and different other aids. The different types of concepts need different kind of content preparation. The drawing of these charts and diagrams is very hectic and time consuming. So most of the teachers depend only on textbook and lecture methods. As a result usually the syllabus in biology remains incomplete.

Computer Aided Instruction.

Computer aided instruction consists of three words computer, aided and instruction. Computer is a machine used to present the audio visual material and instruction is transfer of the knowledge. CAI is the method of teaching in which a computer is used to present the audio visual material to the students. It is used to teach abstract and complex concepts, explain figures and charts in a very limited time with ease. The students remain attentive and most of the syllabus gets completed in minimum time. Computer Aided Instruction is the direct use of the computer to teaching. It acts as a super teaching machine fulfilling the needs of a number of students at the same time the visual aspects which engage the students in a video world make the learning more interesting and easy to understand (Stone [5]).

As the comprehension level of the students increases, their interest to

gain knowledge of complex and abstract concepts increases. (Matheson and Achterberg [4]).

One potential use of computer-enhanced instruction is to complement lecture with graphs, sounds and visuals. (Kolasa and Miller [2])

Aims and objectives

The current research was carried out in order to accomplish the following goals:

(1) To see how CAI compares to the lecture method when it comes to how well class 10th students do in biological science.

(2) To compare class 10th students' retention levels in biology after being taught using the CAI technique versus the lecture mode of instruction.

Hypotheses

The hypotheses in the current investigation were formulated in the following manner:

(H1) At the pre-test stage, there is no significant difference in the academic achievement of class 10th children when subjected to CAI versus those subjected to the lecture method.

(H2) There is a significant difference in the academic achievement of class 10th children in biology when subjected to CAI as compared to those subjected to the lecture method at the post-test stage.

(H3) There exists a significant difference in the retention of class 10th children in biology when subjected to CAI as compared to those subjected to the lecture method at the retention test stage.

Review of Related Literature

P. Jeyamani, [7] Developed a CAI package in Physics for class XI children's. The experimental group received CAI, and after the experiment, it was discovered that the experimental group performed better on the post test. The difference was found to be insignificant in terms of sex and medium of instruction.

Soyibo and Hudson [17] analysed the effect of computer-assisted instruction, lectures and discussion methods on XI class children's attitude

towards biology. The findings revealed that the children of biology who were taught through computer-assisted instruction had better attitudes as compared to those taught through lecture and discussion methods.

V. Kumar, [14] conducted a study on “A Comparative Study of the Effectiveness of CAI and Home Activity on “Mechanics for X Standard Pupils”. It was found that the CAI affected students’ much more than home activities.

M. K. Mahmood and M. S. Mirza, [15] The efficiency of computer-assisted instruction (CAI) on students’ accomplishments in general science was investigated in this experimental study when compared to the traditional mode of education in general science (TMI). This experimental investigation was carried out in a public secondary school in the Pakistani city of Lahore. A post-test only control group experimental design was used on paired groups of students who were matched in terms of their intellectual capacity. The experimental group used the CAI programme, which included interactive tutorials in the Urdu language, to assist them in their learning. The control group’s classroom education was conducted using a textbook-based lecture technique, which is the most common instructional approach in school systems across Pakistan, according to the researcher. The findings of this investigation were reported in the scientific journal Science in 2012. An achievement test was administered to each group after 2-week duration of treatment in order to assess their previous understanding, retention, and applicability of how much they had acquired thus far. Comparisons were made between the experimental group and the control group, and the experimental group outscored the control group across all three aspects of the achievement exam. Apart from that, the CAI team outscored the TMI group in a variety of broad science subject areas across a wide range of questions.

Methodology

The present research study is aimed at ascertaining the effect of computer-aided instruction in comparison with the lecture method of classroom teaching on selected units in biology for the students of class 10th. The first phase of this study was concerned with the development of computer-aided instructional material for a selected unit, and in the second phase, an experiment was conducted to determine the effectiveness of

computer-aided instruction and the lecture method on academic achievement and retention of class X students in biology. The following are the specifics of the methodology used:

Research Design

A pre-test, post-test, and control group experimental design to compare the effects of two different teaching methods, computer-assisted instruction and the lecture method. This way, the researchers could draw a conclusion about which method worked best.

There were two groups: one was named “Experimental” and the other was known as the “Control Group.” The groups were matched on the basis of the scores achieved by the students on the intelligence test. Both groups were pretested to compare their academic achievement. An experimental group was exposed to CAI and the control group was exposed to the lecture method of teaching, and after treatment, a post-test was conducted on both the groups to see the effectiveness of the experimental group and control group on academic achievement and retention.

Population for Sample

In this study, the population consists of all students in class 10th in the district of Baramulla. A sample: since the population is usually too large, a smaller sample is chosen as a representative of the population, which is known as a sample.

Selection of the Sample

The present research was done in two phases. For the first phase of teaching, learning materials were developed for both the CAI and the lecture method. In the second phase, experiments were conducted on a sample of 50 students each for the CAI and lecture method. For the final experimentation, out of all the districts, Baramulla district was selected. For selecting the schools for the experiment, the investigator surveyed the government schools with computer labs in the district of Baramulla and prepared a comprehensive list. Then one school, namely the government higher secondary school in Pattan, was selected in which a well-equipped computer laboratory and a power backup system were installed and functional.

From the list of tenth grade students present in all the computer-labeled

schools in the district of Baramulla, a sample of 100 students was selected randomly. An intelligence test was administered and these 100 students were divided into two groups: experimental and control. Although 50 students for the experimental group and 50 students from the control group were selected in the beginning, at the end of the analysis, only 47 students in the experimental group and 48 students in the control group were retained. In other words, there were 100 students in the beginning, and due to sample mortality, only 95 were retained at the end of the experiment.

Tools Used

Two types of tools were used for achieving the objectives: The first are the instructional tools, and the second are the measuring tools. Both the tools were developed by the researcher himself. But raven's standard progressive matrices were used by the investigator, which were developed by J. C. Raven (2005).

Instructional Tools

Instructional tools mean the instruments used to impart instructional material to the pupils. The investigator himself developed the instructional tools. These were:

- (a) Instructional material for CAI
- (b) Lesson plans for Lecture method

Instructional Material for CAI

Based on the ADDIE model, the CAI package was prepared through five phases: analysis, design, development, implementation, and evaluation. The content included the first two chapters of biology for class 10th NCERT. This package was made carefully, taking care of all the objectives. At each stage, experts were consulted, and the audio and video effects were synchronized. The CAI package was given in the form of a compact disc.

Lesson Plans for Lecture Method

The lecture method, which is the traditional method of teaching, was used to teach the first two chapters of biology by one of the investigators himself. A specific time duration that is 40 minutes was maintained each day.

Measuring Tools

Measuring tools are tools that were used to assess the change in student behaviour in terms of academic achievement and retention. For this purpose, Raven's Standard Progressive Matrices (2005), criterion-referenced tests, and retention tests were used.

Raven's Standard Progressive Matrices

Raven's Standard Progressive Matrices (RSPM) is a well-known intelligence test that has been used in a variety of research and application situations. Children in class 10th were tested using Raven's Standard Progressive Matrices (2005), which were developed to assess their intelligence. This was applied to a group of children in order to equalise two groups for testing on the grounds of respective intellect levels before the study begins.

Criterion-Referenced Tests (CRT)

After undergoing experimental treatment, criterion-referenced tests were used to determine student's academic achievement in relation to predefined instructional objectives. In the current study, two criterion-referenced tests were developed, validated, and used. There was one criterion-referenced test for each unit. The items on the test were multiple-choice questions. These CRTs were similar in terms of CAI and lecture methods. Each item carries one mark. There were a total of 140 marks, 70 for each unit.

Retention Tests

Retention tests determine the capacity to recall information after a certain period of time. It is concerned with the student's ability to recall the taught material. It was decided to make retention tests to see how well students learned over a month of CAI courses and the lecture method. For this study, two retention tests were developed to measure the retention of the students for two units and were validated in the parallel form of the criterion test. There was one retention test for each unit. The maximum score was 140. Thus, after a period of one month, a retention test was administered to each group to measure the retention of students.

Data Collection

The information was gathered in accordance with the goals. Data was collected on three different occasions. Before interaction with CAI and the method of instruction in the lecture, both research participants and pupils will be given a pre-test before the experiment begins. These scores are called “pre-test scores.” After the completion of each unit, a criterion reference test was delivered to the pupils of both research participants to know their scores of academic achievement. These scores are called “post-test scores.” A retention test was administered to both the research groups after one month of study for each unit. The test scores obtained are called “retention scores.”

Analysis, Interpretation and Conclusion

A *t*-test was used in order to determine whether there was a significant change in the total mean of scholastic achievement points on pre-tests for the experimental group and control group. The outcomes are provided in Table 1.

| Groups | N | Mean | S.E. | t-value | Level of Significance |
|--------------------|----|-------|------|---------|-----------------------|
| Experimental Group | 47 | 31.91 | 1.63 | 0.82 | Not Significant |
| Control Group | 48 | 30.57 | | | |

It can be seen in the first row of Table 1. This study discovered that the overall mean of scholastic performance scores for both the research participant groups on the pre-test was 31.91 and 30.57, respectively, with a standard error of 1.63. According to the results, the difference in *t*-values seen between the two groups is 0.82. As a result, the difference in overall mean scores between groups was not statistically significant. It indicates that, at the pre-test stage, the scholastic success level of participants was relatively similar to the scholastic performance level of control subjects on both units of biology in class 10th. It also suggests that both groups could be treated on a nearly equal basis for their performance at the beginning of the study.

| Groups | N | Mean | S.E. | t-value | Level of Significance |
|--------------------|----|-------|------|---------|-----------------------|
| Experimental Group | 47 | 28.17 | 1.41 | 0.31 | Not Significant |
| Control Group | 48 | 27.73 | | | |

On the pre-test of unit-I (life processes), the mean scholastic performance scores of the experimental and control groups were found to be 28.17 and 27.73, respectively, with a standard error of 1.41. This can be seen from the table above, where the mean scholastic success results of both groups were found to be 28.17 and 27.73, respectively. The difference in t-value between the two groups is calculated to be 0.31.

Thus, the result showed that there was no statistically significant difference in scores between the two groups. It denotes that academic achievement level of pupils of experimental group was almost equal to the academic achievement level of students of control group in unit-I of biology at Pre-test stage as both the groups possess similar level of attainment.

| Groups | N | Mean | S.E. | t-value | Level of Significance |
|--------------------|----|-------|------|---------|-----------------------|
| Experimental Group | 47 | 35.65 | 3.2 | 0.70 | Not significant |
| Control Group | 48 | 33.41 | | | |

As shown in the above table, on the pre-test for unit-II (control and coordination), the total scholastic performance values for both groups were determined to be 35.65 and 33.41, respectively, with an SD of 3.2 points between them. According to the results, the difference in t-values between the two groups is 0.70. As a result, there was no statistically significant difference between the mean scores of the two groups. It denotes that academic achievement level of pupils of experimental group was almost equal to the academic achievement level of students of control group in unit-II of biology at Pre-test stage as both the groups possess similar level of attainment.

On the basis of results from above three tables it can be concluded that both the groups were almost similar for their entry level behaviour before starting the experiment on each unit. The estimated t-value was not statistically significant at either the 0.05 or the 0.01 level. Hence, these tables indicate that the first hypothesis that "There exists no significant difference between secondary students exposed to CAI (Experimental group) and to Lecture method (Control group) at Pre-test stage" is accepted.

Section II. The results of the post-test comparison between the mean academic achievement scores of both groups in biology, when the t-test was

used to compare the overall mean scholastic performance values of the post-tests of the experimental group and the control group, it was discovered that the difference was statistically significant, and the findings are displayed in the table. When it comes to post-tests of each unit of biology, the significance of the difference between the total scholastic success values of both groups on post-tests of each unit of biology was already discovered by using the t-test and the findings are provided in Tables.

| Groups | N | Mean | S.E. | t-value | Level of Significance |
|--------------------|----|-------|------|---------|---------------------------|
| Experimental Group | 47 | 50.12 | 1.08 | 13.83 | Significant at 0.01 level |
| Control Group | 48 | 35.14 | | | |

This is seen in the table that overall mean scholastic performance values of both groups on post-tests of 2 units are 50.12 and 35.14, respectively, with a standard error of 1.08 for the two groups. The difference in t-values between the two groups is calculated to be 13.83. It shows that there is a statistically significant difference between the pupils in two groups at the 0.01 level. The comparison of mean academic performance demonstrates, however, that the mean student performance scores in biology of the experimental group are much higher than those of the control group, as previously stated. As a result, it is obvious that the implementation of CAI had a greater impact on overall student performance ratings than the lecture technique. Participants in the experimental group had been exposed to CAI; they learned the concepts with complete concentration, grasping the conceptual and complicated ideas that were presented to them. The pupils in the control group, on the other hand, did not have this opportunity. We're going to keep the second hypothesis, which says that "there is a statistically significant difference in the scholastic performance of class 10th biology students who have been treated with CAI and those who have been treated with lecture method at the post-test stage.

| Groups | N | Mean | S.E. | t-value | Level of Significance |
|--------------------|----|-------|------|---------|---------------------------|
| Experimental Group | 47 | 60.24 | 4.24 | 3.56 | Significant at 0.01 Level |
| Control Group | 48 | 45.14 | | | |

On post-tests of unit-I (life processes), the total academic achievement results of both groups were 60.24 and 45.14, respectively, according to the table, with a standard error of 4.24. The difference in t-values between the two categories is calculated to be 3.56. It shows that there is a statistically significant difference between the pupils in the 2 categories at the 0.01 level. According to the results based on the mean scholastic performance in biology, the total test scores are greater than the standard scores of the control group. As a result, research suggests that the CAI was more effective than the lecture method in terms of enhancing student's academic achievement. Participants in this study group were taught how to CAI and were able to grasp the subject with complete concentration.

| Groups | N | Mean | S.E. | t-value | Level of significance |
|--------------------|----|-------|------|---------|---------------------------|
| Experimental Group | 47 | 40 | 4.54 | 3.27 | Significant at 0.01 level |
| Control Group | 48 | 25.14 | | | |

It is obvious again from the table here that the mean academic achievement scores of both research groups on post-tests of unit-II (control and coordination) are found to be 40 and 25.14, respectively, with a S.E. of 3.27 on the post-tests of control and coordination. According to the results, the t-value between the 2 categories is 3.27. It shows that there is a statistically significant difference between the pupils in two groups at the 0.01 level. An additional finding of the purpose of comparing scholastic performance scores in biology is that the total test scores are significantly higher than those of the control group. As a result, it can be concluded that the CAI was more efficient and efficient than the oral technique in terms of improving student's academic achievement. Students in the experimental group that were subjected to CAI were able to grasp the subject with complete concentration.

The section III. The retention exam results, computed in respect of mean, error variance, and t-values acquired from both groups on retention tests for 2 units of biology after a month of experimentation, are presented in this section.

When the t-test was used, it was discovered that the difference between

the total retention mean values of biology on the retention assessments of both groups was statistically significant. The test direct outcomes are provided in the table. The significance of the difference between the retention total values of both parties on retention tests from every unit of biology was also determined by using the t-test, which is a statistical test.

| Groups | N | Mean | S.E. | t-value | Level of Significance |
|--------------------|----|-------|------|---------|---------------------------|
| Experimental Group | 47 | 60.12 | 1.22 | 12.22 | Significant at 0.01 level |
| Control Group | 48 | 45.13 | | | |

As shown in the table, the overall retention mean score of both groups on the memory tests of 2 units of biology in class 10th is 60.12 and 45.13, respectively, with a standard error of 1.22. The difference in t-values between the 2 research categories is calculated to be 12.22. According to the results, the participants in the 2 categories differed statistically substantially at the 0.01 level of significance. The analysis of overall retention mean scores reveals that the retention mean score on recall exams in the treatment group is greater than the retention mean score in the control group, according to the findings. In other words, when compared to the lecture method, the use of CAI is more beneficial for remembering ideas and theories. The explanation seemed to be that the graphic elements of the content given helped the participants in the experimental group who were subjected to CAI better understand biological principles. The participants in the control group, on the other hand, did not remember the notion for an extended period of time since students were memorizing the biological concepts that were presented through the lecture technique. The conclusion is that CAI was beneficial in maintaining the notion of biology in a meaningful way for the students. It is therefore decided to keep the third hypothesis, which states that "there is a statistically significant difference in the recall of class 10th students in biology while subjected to CAI against those who are treated to lecture technique at the retention test stage.

| Groups | N | Mean | S.E | t-value | Level of Significance |
|--------------------|----|-------|-------|---------|---------------------------|
| Experimental Group | 47 | 55.24 | 10.75 | 2.15 | Significant at 0.05 level |
| Control Group | 48 | 32.12 | | | |

On the retention-test for unit-I (life processes), as is shown in the table, the mean retention scores of both groups were revealed to be 55.24 and 32.12, respectively, with a standard error of 10.75. The difference in t-values between the two categories is calculated to be 2.15. It means that, just at the 0.05 level of significance, there is a statistically significant difference between the two groups of learners. A third finding from the examination of retention mean scoring is that the retention mean score of biology on the retention-test of the treatment group is greater than the retention mean scoring of the control group. In other words, as compared to the lecture method, the CAI is more helpful to students in retaining topics and theories. The explanation seemed to be that the visual elements of the content given helped the participants in the testing group who were subjected to CAI better understand biological principles. The participants in the control group, on the other hand, were unable to remember the idea of biology for such a lengthy span of time since they were forcing the notion presented through the lecture approach into their heads. CAI helped the students keep the idea of biology in their minds in a way that made sense to them.

| Groups | N | Mean | S.E | t-value | Level of Significance |
|--------------------|----|-------|------|---------|---------------------------|
| Experimental Group | 47 | 65 | 1.42 | 4.83 | Significant at 0.01 level |
| Control Group | 48 | 58.14 | | | |

As from the table, it must be said that the retention means values of both research on the retention-test for unit-II (control and coordination) are determined to be 65 and 58.14, with a standard error of 1.42, respectively. The difference in t-values between the two different groups is calculated to be 4.83. According to the results, the pupils in the two different groups differed statistically substantially at the 0.01 level of significance. An additional finding from the purpose of comparison values would be that the mean score on the retention test of biology for the treatment group is greater than the mean score for the control condition. It demonstrates that, as compared to other instructional methods, CAI is more successful at remembering biological concepts and principles. The explanation seemed to be that the visual elements of the content given helped the participants in the testing group who were subjected to CAI better understand biological principles. The

participants in the control group, on the other hand, were unable to remember the topics of biology for a lengthy span of time since they were still forcing the notions presented through the lecture approach into their heads. CAI helped the students keep the idea of biology in their minds in a way that made sense to them.

Mostly on the grounds of the findings and evaluation of the outcomes from the tables above, it can be inferred that learners who received computer-assisted training recalled more fundamental facts than pupils who received lecture-based teaching. This results in the retention of the third hypothesis, "There is a statistically significant difference in the retention of class 10th students in biology when subjected to CAI against those who are subjected to lecture technique at the retention test stage.

Findings

1. Computer aided instruction promises to improve teaching learning process as it combines text and images.

2. It increases the academic achievement of the students as well as increases their retention level, indicating its long-lasting impression on the thoughts of the participants.

3. Training must be given to the professionals for developing of computer aided instruction material for children keeping in view its importance.

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