EFFECTIVENESS OF COMPUTER AIDED LEARNING IN SCIENCE AT SECONDARY LEVEL

THESIS SUBMITTED TO THE
SAURASHTRA UNIVERSITY
FOR THE DEGREE OF
Doctor of Philosophy
(EDUCATION)

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STATEMENT UNDER UNIVERSITY Ph.D. RULES
ORDI. Ph.D. 7

I here by declare that,

(a) The research work embodied in this thesis on ***"Effectiveness of Computer Aided Learning in Science at Secondary Level"*** submitted for Ph.D. degree has not been submitted for any other degree of this or any other university or any previous occasion.

(b) To the best of my knowledge no work of this type has been reported on the above subject, since I have discovered new relation of facts, this work can be considered to be contributory to the advancement of knowledge on Psychology and Education; and

(c) All the work presented in the thesis is original and wherever reference have been made to the work of other it has been clearly indicated as such and the sources of information included in the bibliography.

Counter Signed by
The Guiding Teacher

Date :

Signature of the
Research Student

Date :

Certificate of Approval

This thesis, directed and supervised by the candidate's guide, has been accepted by the Department of Education, Saurashtra Universirty, Rajkot in the fulfillment of the requirements for the degree of -

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Title : "Effectiveness of Computer Aided Learning in Science at Secondary Level"

Candidate : Barot Nidatt Prabhudas

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Dr. Janak Makvana

Date :

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- Nidatt Barot

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CHAPTER - 1
PROBLEM INTRODUCTION

CHAPTER - 1
PROBLEM INTRODUCTION

1.1 INTRODUCTORY :

Education can be imparted only by a teacher and never by method, man can learn only from a man.

- Ravindranath Tagore

The destiny of India is being shaped in the class room.

To bring about a change in a learner's behaviour through teaching, the learner has to acquire knowledge by any means. The nature has given five senses to a learner, by the help of which he can learn something. Eyes, ears, nose, tongue and skin are those five senses with the help of which a learner learns.

If a learner acquires 100% knowledge he acquires it as under :

1% by tastes with the help of tongue

1.5% by touch with the help of skin

3.5% by smell with the help of nose

11% by hearing with the help of ears and

83% by questions with the help of eyes.

Generally in a classroom and especially if we think about the secondary stage and keep in mind the subject of science, the learner's most of the learning occurs with the help of ears and eyes. In these situations audio-visual equipments can be more useful in the subject of science. The instruments like :

- Epidoscope
- Epidioscopic cards
- Overhead projector
- Graphs
- Charts
- Samples
- Film strips
- Bulletin boards
- Models
- Black boards etc. - are visual equipments.

Instruments like radio, tape-recorder are audio equipments and instruments like movies, computers, televisions are audio-visual equipments.

Many researches have proved that the educational instrument - assisted teaching during class teaching has improved the quality of education.

In 21st century, the computer has emerged as a most popular and reliable audio-visual equipment. From child education to higher level of medical or scientific researches the use of computer can further be extended to help the students of secondary level in the subject of science, but how can it be used and implemented has been thought of, and this research has been conducted.

1.2 PROBLEM NARRATION :

Before taking up any kind of research, the selection of the study subject becomes an essential element for a researcher. It becomes necessary for researcher to examine its different aspects like expert's suggestions, study of previous studies as well as a detailed study of various reference books.

After examining such points the researcher prepares a design of study field in his mind.

Before conducting this study, to select a subject of his choice, the researcher during his library work decided to select a subject regarding attitude keeping in mind different aspects of this study. For this, according to the suggestion of a counsellor, the researcher studied the previously conducted researches, during which study the researches of the category of M.Ed. and Ph.D. were included.

Besides, the study of educational and related articles of national and international journals was made and after consulting different subject experts, the subject for more study was selected. Finally, after discussions with counselor the title of the subject of study was finalized as under :

"Effectiveness of Computer Aided Learning in Science at Secondary Level"

In this study, it was tested whether the teaching method through computer as a teaching instrument was effective or not, in comparison to the traditional lecture method for teaching science subject at secondary level.

The study of effectiveness of teaching method on science achievement, science confidence and science retention will be conducted in this study.

This research was done by experimental research method. To conduct the experiment, six experiments were conducted on boys and girls of Class 8, 9 and 10 of secondary schools of Rajkot city.

1.3 VARIABLE INVOLVED IN THE STUDY :

To recognize and genuinely define the variables involved in the study problem is an important step in the study process. For this, it is necessary to understand the variable and its types.

The effectiveness of teaching method as an independent variable was examined. As an independent variable the teaching method consisted of two categories :

i) Teaching method with the help of computer

ii) Lecture method

1.3.1 Dependent Variable :

Dependent variable is a factor which is being observed and measured to examine the effect of independent variable. The factor which evolves or which is removed or being changed by the implementation, removal or improvement in independent variable is known as dependent variable.

In this study, as the study of attitude of the study towards computer education was to be done. The responses / attitude of students towards computer education was taken as dependent variable.

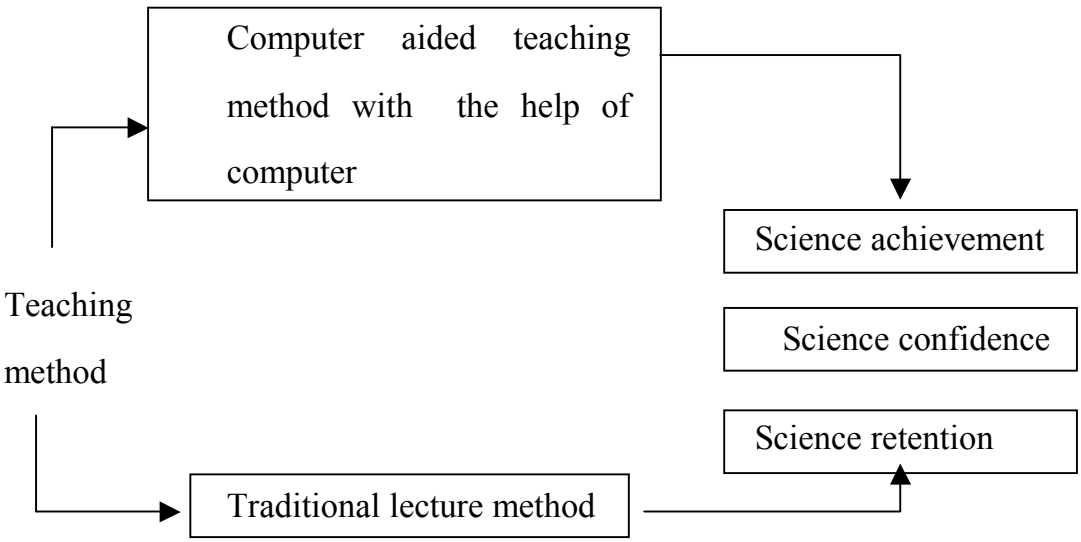
The dependent variables covered in this study were as under :

- Achievement of Science
- Confidence in Science
- Retention of Science

1.3.2 Relationship between independent variable and dependent variable :

The effect of teaching method on science achievement, science confidence and science retention has been tested in this study.

The relationship between independent variable and dependent variable can be figured as under :



1.4 VARIABLE :

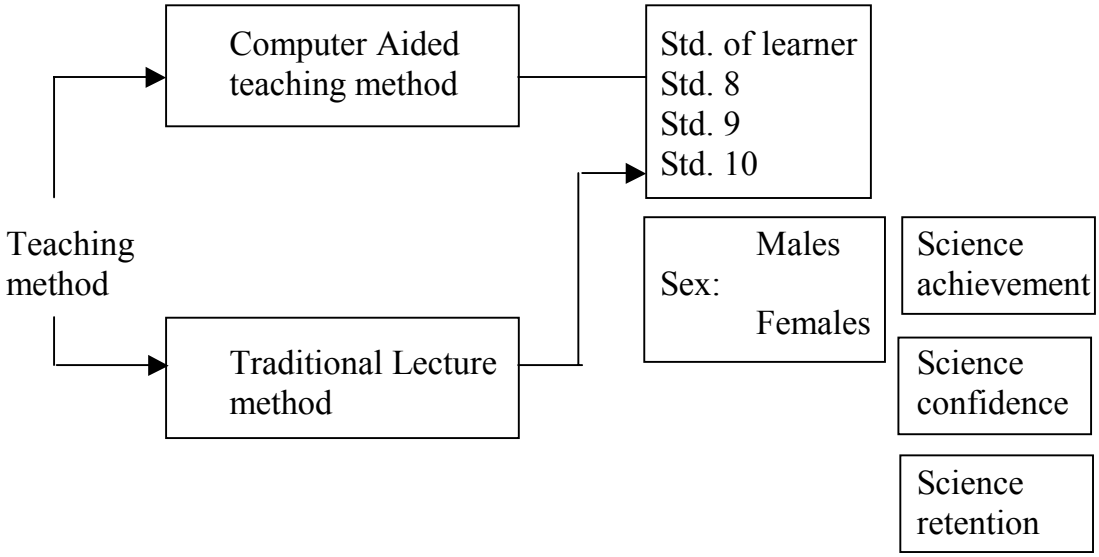
The variable, which affects the relationship between independent variable and dependent variable, is known as change variable. The change variables and their categories chosen in this study are shown as under :

1.4.1 First change variable was 'sex' which had two categories of males and females.

1.4.2 Second change variable was standard which had three categories of Std. 8, Std. 9 and Std. 10.

1.4.3 Relationship between independent variable, dependent variable and change variable.

The pictorial presentation of relationship between independent variable, dependent variable and change variable in this study is shown as under :



1.4.4 Controlled variable :

In the research which is done by experimental method, when the researcher begins his experiment the thing which he must take care of is that during the experiment the researcher acquires the measurement of effect of only that variable the effect of which he wishes to examine. The effect of other influencing variables is made ineffective during the course of the experiment.

The controlled variables in this study were as shown under :

- ➢ Subject
- ➢ Unit
- ➢ Medium
- ➢ Level of Student
- ➢ Standard
- ➢ School environment
- ➢ Teaching ability of teacher

1.5 RACTICAL DEFINITION OF TERMS :

The researcher gives the meaning of variables covered in the study and main terms in terms of their measurement. This is called practical definition of terms. Certain terms used in this study were arranged by the researcher in terms of the measurement of the study work.

➢ ***Lecture Method :***

The researcher had accepted in this study that the way a teacher teaches science in a class in usual situation, by traditional way of teaching is lecture method.

➢ ***Computer Aided Teaching Method :***

In this study the teaching of science was done with the help of computer software, which is very useful for the purpose. This type of teaching method has been accepted as the teaching method through computer.

➢ ***Achievement of Science Subject :***

After the teaching work of a unit of science a teacher - made test on related unit will be conducted. The scores obtained by the students in this test were accepted as achievement of science.

➢ ***Confidence of Science Subject :***

To know the confidence of the subject of science the test designed by Mr. Dinesh K. Sejpal, namely - "I want to speak about mathematics" was used. Researcher converted this test for the use of measuring confidence of science. The pilot survey was done after converting the test to use for science subject instead of mathematics. The scores obtained by the students were accepted as science confidence.

➢ ***Retention of Science Subject :***

The researcher conducted a teacher made test during the experiment, and the same test was conducted again after two months, the difference between first and second scores obtained by the same subject were marked as retention score. Lower the amount of difference higher is the retention.

1.6 OBJECTIVES OF STUDY :

The objectives of the study were :

➢ To study the effectiveness of teaching method on achievement of science subject with the help of a computer in comparison to that of traditional lecture method.

➢ To study the effectiveness of teaching method on confidence of science subject, with the help of computer in comparison to traditional lecture method.

➢ To study the effectiveness of teaching method on retention of science subject, with the help of computer in comparison to traditional lecture method.

Six experiments were conducted on six different types of persons / students as under :

Experiment - 1 : Boys of Std. 8

Experiment - 2 : Girls of Std. 8

Experiment - 3 : Boys of Std. 9

Experiment - 4 : Girls of Std. 9

Experiment - 5 : Boys of Std. 10

Experiment - 6 : Girls of Std. 10

1.7 HYPOTHESES OF THE STUDY :

After determining the objectives and title of the study problem the researcher constructs temporary answers or solutions which are called hypotheses.

By carefully preparing hypotheses on a problem :

- ➢ Nature of the problem becomes clear
- ➢ The study is centralized
- ➢ The study work becomes easy
- ➢ Get better understanding about study method
- ➢ Get better knowledge about the instruments of information collection
- ➢ Get the idea of "what the information analysis technique should be".

The researcher takes into account the previous studies, theoretical facts and his own experiences and forms rules which suggest definite direction to the acquired results, which are called hypotheses. For the purpose of statistically examining such hypotheses on the basis of probability model they are converted into the statements like "may not differ" or "may not relate" which is called null-hypotheses.

The researcher had framed the study hypothesis on the basis of objectives in this study.

1.7.1 Research hypothesis :

1. In terms of the science subject of Std. 8, the average of science achievement scores of boys who received teaching by computer and of those who received by lecture method will have a significant difference between them .

2. In terms of the science subject of Std. 8, the average of science confidence scores of boys who received teaching by computer and of those who received by lecture method will have significant difference between them.

3. In terms of the science subject of Std. 8, the average of scores of science context retention of boys who received teaching by computer and of those who received by lecture method will have significant difference between them.

4. In terms of the science subject of Std. 8, the average of science achievement scores of girls who received teaching by computer and of those who received by lecture method will have significant difference between them.

5. In terms of the science subject of Std. 8, the average of science confidence scores of girls who received teaching by computer and of those who received by lecture method will have significant difference between them.

6. In terms of the science subject of Std. 8, the average of scores of science context retention of girls who received teaching by computer and of those who received by lecture method will have significant difference between them.

7. In terms of the science subject of Std. 9, the average of science achievement scores of boys who received teaching by computer and of

those who received by lecture method will have significant difference between them.

8. In terms of the science subject of Std. 9, the average of science confidence scores of boys who received teaching by computer and of those who received by lecture method will have significant difference between them.

9. In terms of the science subject of Std. 9, the average of scores of science context retention of boys who received teaching by computer and of those who received by lecture method will have significant difference between them.

10. In terms of the science subject of Std. 9, the average of science achievement scores of girls who received teaching by computer and of those who received by lecture method will have significant difference between them.

11. In terms of the science subject of Std. 9, the average of science confidence scores of girls who received teaching by computer and of those who received by lecture method will have significant difference between them.

12. In terms of the science subject of Std. 9, the average of scores of science context retention of girls who received teaching by computer and of those who received by lecture method will have significant difference between them.

13. In terms of the science subject of Std. 10, the average of science achievement scores of boys who received teaching by computer and of those who received by lecture method will have significant difference between them.

14. In terms of the science subject of Std. 10, the average of science confidence scores of boys who received teaching by computer and of those who received by lecture method will have significant difference between them.

15. In terms of the science subject of Std. 10, the average of scores of science context retention of boys who received teaching by computer and of those who received by lecture method will have significant difference between them.

16. In terms of the science subject of Std. 10, the average of science achievement scores of girls who received teaching by computer and of those who received by lecture method will have significant difference between them.

17. In terms of the science subject of Std. 10, the average of science confidence scores of girls who received teaching by computer and of those who received by lecture method will have significant difference between them.

18. In terms of the science subject of Std. 10, the average of scores of science context retention of girls who received teaching by computer

and of those who received by lecture method will have significant difference between them.

1.7.2 Null Hypotheses :

The research hypotheses are presented in the form in which they can be tested. In this research the research hypotheses have been transformed into null hypotheses.

1. In terms of the science subject of Std. 8, the average of science subject achievement scores of boys who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

2. In terms of the science subject of Std. 8 the average of scores of science subject confidence of boys who received the teaching through computer and of those who received by lectures method will not have significant difference between them.

3. In terms of the science subject of Std. 8 the average of scores of retention of science context of boys who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

4. In terms of the science subject of Std. 8 the average of science subject achievement scores of girls who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

5. In terms of the science subject of Std. 8 the average of scores of science subject confidence of girls who received the teaching through computer and of those who received by lectures method will not have significant difference between them.

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8. In terms of the science subject of Std. 9 the average of scores of science subject confidence of boys who received the teaching through computer and of those who received by lectures method will not have significant difference between them.

9. In terms of the science subject of Std. 9 the average of scores of retention of science context of girls who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

10. In terms of the science subject of Std. 9 the average of science subject achievement scores of girls who received the teaching through

computer and of those who received by lecture method will not have significant difference between them.

11. In terms of the science subject of Std. 9 the average of scores of science subject confidence of girls who received the teaching through computer and of those who received by lectures method will not have significant difference between them.

12. In terms of the science subject of Std. 9 the average of scores of retention of science context of boys who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

13. In terms of the science subject of Std. 10 the average of science subject achievement scores of boys who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

14. In terms of the science subject of Std. 10 the average of scores of science subject confidence of boys who received the teaching through computer and of those who received by lectures method will not have significant difference between them.

15. In terms of the science subject of Std. 10 the average of scores of retention of science context of boys who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

16 In terms of the science subject of Std. 10 the average of science subject achievement scores of girls who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

17. In terms of the science subject of Std. 10 the average of scores of science subject confidence of girls who received the teaching through computer and of those who received by lectures method will not have significant difference between them.

18. In terms of the science subject of Std. 10 the average of scores of retention of science context of girls who received the teaching through computer and of those who received by lecture method will not have significant difference between them.

1.8 SIGNIFICANCE OF THE STUDY :

In the present age when the computer has attained the place of a best instrument, it became necessary to know its fruitfulness in teaching of science at secondary level. For this the softwares of science content of Std. 8, 9 and 10 which could be activated by computer were used.

The ready made computer software of the subject of Science are effective tool. Under this research it was checked that how the students confidence in the Science subject can be gained and how the retention in the subject is made effective when the software is used while teaching Science as a school subject.

1.9 SCOPE OF THE STUDY :

This study was taken up to test the effectiveness of the teaching done with the help of computer in science at secondary level.

- ➢ The experiments were conducted on selected units of science subject of Std. 8, 9, 10 and the computer software of which were easily available.
- ➢ The experiments were conducted on the students of Std. 8, 9 and 10 at secondary level.
- ➢ In comparison to the lecture method, the effectiveness of the computer aided teaching method was accepted for the teaching through computer.
- ➢ To test the effectiveness of both the methods all the variables, such as achievement of science, confidence of science and retention of science context were taken into consideration.

1.10 LIMITATIONS OF THE STUDY :

1. The identical sample method was used to select the school for experiment.
2. To measure the educational achievement, teacher-made achievement test was implemented.
3. In this research the students who had the primary knowledge of computer were selected as the sample.

1.11 DESIGN OF THE STUDY :

- ➢ Determination of objectives
- ➢ Formation of hypotheses in accordance with objective
- ➢ Software selection

- ➢ Four units of Science subject of each Std. 8, 9, 10 were selected
- ➢ Analysis of the context of selected unit was done
- ➢ Class organization was done
- ➢ Teacher made test was prepared for each unit
- ➢ To measure the confidence of Science subject, the science inventory was developed with the help of the inventory made by Sejpal D. K. for mathematics subject.
- ➢ Appropriate experimental design was selected
- ➢ Experimental work was conducted
- ➢ After experimental work the achievement of science was measured
- ➢ After experimental work the confidence of science was measured
- ➢ After experimental work the retention of science was measured
- ➢ Marking of the subjects of two groups included in each experiment was done in terms of all the three dependent variables
- ➢ The analysis was conducted on each experiment through T-test
- ➢ With the help of statistical analysis the null hypotheses and research hypotheses were tested
- ➢ The obtained results were interpreted
- ➢ Appropriated implications were prepared

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CHAPTER – 2
REVIEW OF RELATED LITERATURE

CHAPTER – 2
REVIEW OF RELATED LITERATURE

2.1 INTRODUCTORY :

Before taking up any kind of study, the related literature is acquired and studied to understand the problem. By review of the related literature the problem becomes clear and it directs the researcher in proceedings in his subject.

The literature in any field forms the foundation upon which all future work is done.

- P. R. Borg

According to Prof. Linkleader till 1990 the printed knowledge of science and technology has been in hundreds of words or figures in billions of times. If this knowledge is read for 18 hrs a day for 365 days at the speed of 3000 words per minute, this work would be completed in twelve years.

From the conclusion of Mr. Link leader it can be said that from the contextual literature related to the relevant study which is in the form of vast sea of knowledge, the study made by the researcher is just like a drop of the sea. Keeping in the limit of the relevant study, the researcher reviewed the related literature.

Mr. H.G. Desai while explaining the importance of related literature states that, “review of the literature becomes necessary for the proper development of the problem.” To prepare the background required for clarification and proper solution of the problem selected by an researcher the review of literature is essential.

The background of the problem can only be clarified if complete inference of related literature for understanding of research plan for problem development occurs. Mr. Agarwal while showing this type of importance states that, “by reexamination of the related literature, the researcher acquires the required understanding of works done so far.

Moreover the information regarding the facts, used by the researcher is also obtained by this kind of study.

By the review of related literature the researcher will be able to make :

- the things to be included in a problem becomes clear;
- the necessity to solve the problem by research can be understood
- appropriate hypothesis to problem can be prepared,
- the source of information becomes clear,
- proper guidance regarding proper instruments and tools for collecting information can be obtained.

This research was taken up to test the effectiveness of the computer assisted teaching programme for the teaching of selected units of science of std. 8, 9 and 10. For this, teaching works was done on two groups separately by two different methods (i) traditional teaching and (ii) computer assisted teaching programme, in which the effectiveness of computer assisted learning programme was to be relatively tested against the traditional method of teaching.

2.1 TRADITIONAL TEACING METHOD :

The traditional teaching method is a method which is based on the old concept of teaching, the old concept of teaching was teacher centered and subject centered.

In traditional teaching method the teacher stubbornly believed in the following things :

- Only the teacher had the right to teach, only he can teach.
- Only method for teaching was to teach by talking
- To teach what is in the text only.
- Teaching work can only be done in class room.

In this method, along with narration the teacher makes use of chalk, board and duster but to a large extent this is a one way method. However, while using this method if the teacher makes use of communication skill, this seemingly weak method can be made effective.

2.1.1 Advantages of traditional teaching :

Although it is based on the old concept of teaching and largely a teacher centred and subject centred, this method carries many advantages also. Long courses can be completed in stipulated time. Moreover, good oration can motivate bright students in their studies. The content can be made interesting through narration skill and communication skill. It facilitates teacher the preparation of teaching plan. The students can be given the training of listening experience

2.1.2 Limitations of traditional teaching :

In this method the student has to act according to the speed and will of the teacher. If the narration, lecture or explanation given by the teacher is not of the required standard, the method turns out to be a failure. There is a possibility of the students becoming passive listeners. Moreover, the craming attitude of students becomes strong. It becomes, to a large extent impossible to develop the mental abilities, logic, observation decision, comparison abilities of students by this method.

2.1.3 Conditions for success of traditional teaching method :

The teacher should follow the standard of students and should give lecture in oral as well as in any understandable way, should not spend whole time in mere oration but instead should allot sometime to the students for questions to be asked by them at the end of lecture. Besides, to avoid the boredom and maintain the interest, the teacher should add some element of humor in his lecture.

In short, the traditional teaching method in which descriptions and narrations are mostly used, is an art of its kind which is very difficult to acquire. It will be unfair to condemn this as an old and useless method.

In fact, the lecture narration itself is a method. Not only that, it also becomes supplementary to most of the educational instruments like display, role playing, dramatically identification, group discussion etc.

2.2 COMPUTER TECHNOLOGY IN THE FIELD OF EDUCATION :

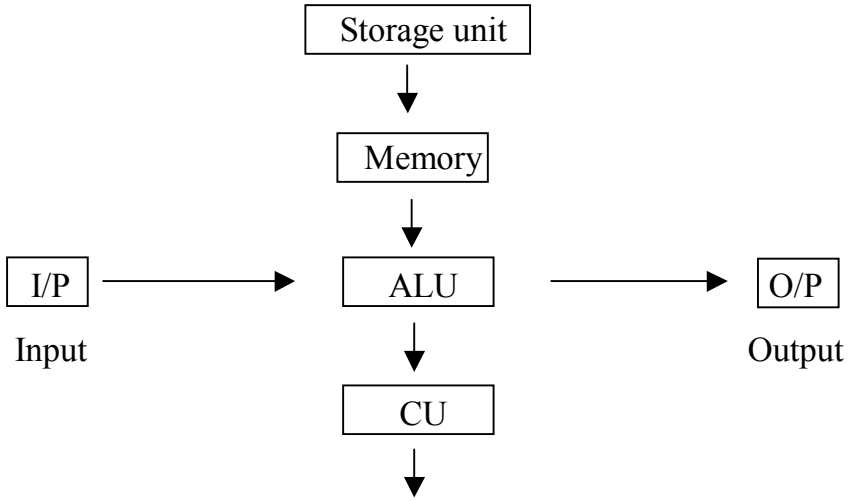
The computer is being used at different levels in educational process. Before looking at the uses and advantages of computer assisted teaching let us acquire some primary clarification of computer technology.

2.2.1 Constitution of Computer :

Computer is an electronic instrument which is used to make calculation and/or control such processes.

The computer has three parts

1. Input unit
2. Output unit and
3. Central processing unit



Central Processing Unit (CPU)

To get the work done by computer it is necessary to provide information. The device which provides information are known as input unit or input device which include keyboard, mouse, scanner microphone etc.

Central processing unit (CPU) is a main part of computer in which the control unit takes decisions about the processing of incoming information and come out with results. In short, it controls the processes of computer.

During the controlling of the process the ALU Arithmetical Logical Unit and memory unit becomes helpful. The arithmetical logical unit performs arithmetical and logical processes whereas the storage of memory required for these messages is alone by memory unit. In the memory unit HDD Hard disk drive and FDD floppy disk drive are involved. Higher the hard disk of a computer, greater will be its capacity to store the matter.

There is an arrangement of units for storage of information which are set in the form of hard disc drive (HDD), floppy disk drive (FDD) and Compact Disc drive (CDD) which sequentially administer the hard disc, floppy disc and compact disc. The hard disc has more storage capacity but its

memory can not be moved from one place to another. Memory in floppy disc can be moved easily but its storage capacity is less. The limitations of these two can be removed in compact disc, that is, the storage capacity of compact disc is more an it can be carried easily. Therefore most of the Software are prepared on compact disc.

The instruments used for bring out results prepared by the computer is called output device. It includes monitor, speaker, printer etc.

2.2.2 Computer system :

Computer is an electronic device. The coordination among different parts of a computer is essential. This coordination needs a system. This computer system has three parts (i) Hardware (ii) Soft ware and (iii) Live ware.

The computer hardware includes input device, out put device and central processing unit. The software is used for hardware. The software does not have physical existence. It is a collection of instructions about the works to be done by a computer.

Different types of people such as computer programmer, computer manufacture and computer user involved with computer are included in live ware.

2.2.3 Computer software and its types :

Instruction are given to the computer for variety of works it does. These instructions are clear, logical and in sequence. Computer software is a collection of instructions which are prepared with the arithmetical and logical capabilities of HDD of computer, to obediently follow the instructions accordingly. The hardware is of no importance without software. The software activates the hardware.

There are three types of software, (i) operating software (ii) application software and (iii) utility software.

1. Operating system (OS) :

It is also called operating system. It is a collection of machine based programmes which act as an interphase, that is interpreter between application software computer and computer hardware. The main function of operating software is an all-round administration or management of the computer system.

There are two types of operating system for personal computer; (i) DOS (ii) Windows. DOS (Disk operating system) is a single user single tasking operating system in which character / text based instruction or commands are used, where as WINDOW is a Window base operating system which is actually an extension of capabilities of DOS. Windows is a graphical user interphase (GUI). Multi tasking provides the facility of multi-tasking and gives on line help.

2. Application software :

The user for the different works such as writing letters, arranging files, looking after financial dealings, drawing pictures, making calculations, doing statistical analysis and watching films uses softwares which are called application softwares. There are two types of application softwares (i) for general use and (ii) for specific purpose.

The softwares for general use are called by the name of packages which are being sold in readymade form for the use. It provides facility of menu based management. There is a facility of help of tools which are application software. These tools include MS word, MS excel and MS power point.

The software for specific purpose are made by programmer according to the tasks required. The software developed for such specific purpose is called tailor made software.

3. Utility software :

The work efficiency of a computer is on decline, especially the computer virus and disc fragmentation lowers the work efficiency of computer. The software used for making the computer efficient again is called utility software. Disc fragmentation software is used to repair the disc fragmentation from computer virus. These software are utility type software.

2.2.4 Use of computer in the field of education :

The use of computer in distance education and classroom teaching is increasing day by day. The computer is specifically used in education in the field of teaching learning, drilling and practicing in field, for adaptation, for learning through trial and error, for acquiring knowledge through games and for evaluation of education.

1. For teaching - learning :

In this approach, the content to be learnt is divided into small parts. To check out whether the student has understood the content or not, questions are asked to him at the end of each part. The answers are being interpreted by the computer and then appropriate feed back is provided. This role of computer is similar to programmed learning. The programmes in the form of linear programmings and branch programms can also be prepared in computer.

2. For drill work and practice :

The theories or laws learnt by students are provided with many reference examples. Whether the student has understood the theories or laws

is examined. Feedback is provided to correct response and after providing treatment to wrong response, subsequently the students are sent to the extent of effective learning by the computer.

3. For adaptation:

In teaching subjects like science the graphical presentation of the topics like understanding of laws of speed, process of nuclear fission, principles of gravitation becomes very difficult. By providing adaptation through computer and by showing examples based on laws, the drill work of concepts can be done.

4. Teaching through trial and error :

In teaching some subjects students are allowed to work on their own. The mistakes or error done by the students is tolerated. They come to know the error and are asked to solve them. After some time they will be able to solve and then are allowed to proceed further. This is the method of teaching through trial and error.

5. Knowledge through computer assisted games :

In this the role of a computer becomes that of a partner of the learner or evaluator of the learner. The vocabulary or general knowledge can be improved through this technique.

6. For evaluation in teaching :

By collecting the questions corresponding to the subject, keeping in mind a particular structure the questions of equal difficult value, can be obtained through computer.

7. For marking and analysis :

The responses of the student can be marked and not only that on the basis of scoring, the sections of test can be analyzed, and by that the efficiency of the students can be analyzed.

2.2.5 The advantages of computer aided learning :

Other than techniques of teaching - learning, special features of computer aided learning can be explained as under :

- ➢ The student can do self learning with self speed
- ➢ During the teaching learning through computer the learner gets continuous response, thus, the teaching work becomes live.
- ➢ Immediate feed-back suitable to given response can be obtained.
- ➢ According to the programmed learning as given by Skinner, the content can be defined into small parts, and subsequently one can proceed further.
- ➢ Student can easily carry the computer to his room, hostel, tutorial room etc.
- ➢ Learning stages can be arranged according to the time schedule.
- ➢ Student can learn on his own and in his own ways.

2.3 REFERENCE LITERATURE USED FOR REVIEW OF STUDY :

For the review - study of this research, researcher had selected :

1) A survey of research in Education
2) Second survey of research in Education
3) Third survey of research in Education
4) Fourth survey of research in Education

5) Fifth survey of research in Education

6) Researches of the category of M.Ed. and Ph.D of Saurashtra University.

➢ In "A Survey of Research in Education" (1974), on the fields related to this research such as (i) programmed learning and (ii) correlates of achievement, a study was conducted on 63 M. Phils. and Ph.D. of Education students and other related faculties. In this study, not a single study was found to b0e conducted on "effectiveness of computer aided method of teaching science".

➢ In "Second Survey of Research in Education" (1979), on the fields related to this research such as (i) educational technology, (ii) correlates of achievement a study was conducted on 70 M.Phils. and Ph.Ds. students of selected education faculty and other related faculties and Research Project. In this study, not a single study was conducted on the study related to "effectiveness of computer aided method of teaching science".

➢ In "Third Survey of Research in Education" (1987), on the fields related to this research such as (i) educational technology, (ii) correlates of achievement, a study was conducted on 118 M.Phils. and Ph.Ds. of education faculty and other related faculties and Research Project. In this study, not a single study was conducted on the study related to "effectiveness of computer aided method of teaching science".

➢ In "Fourth Survey of Research in Education", on the fields related to this research such as (i) Research in Curriculum, (ii) Research in

Mathematics education, (iii) Research in Education technology, (iv) Research in correlates of achievement (v) Research in elementary education, a study was conducted on 351 M.Phils. and Ph.Ds. of education faculty and other related faculties and Research Project. In this study, the study related to this research was of Patadia (1987), the summary of which is given later.

➢ In "Fifty Survey of Research in Education", on the fields related to this research such as (i) Primary Education, (ii) Secondary Education, (iii) Higher Education, (iv) Mathematics Education, (v) Educational Technology, (vi) Correlates of Achievement. a study was conducted on 316 M.Phils. and Ph.Ds. of education faculty and other related faculties and Research Project. In this study, not a single study was conducted on the study related to "effectiveness of computer aided method of teaching science".

➢ A study was conducted on 385 researches of the category of M.Ed. and 44 researches of the category of Ph.D. in department of Education, Saurashtra University. In this study, the studies conducted by Mehta (1989) and Dave (1992) of M.Ed. category and Dave (1997) and Kundaliya (2001), Karia (2001), Ramanuj (2001) of Ph.D. category were found relevant to the research, the summary of which is given ahead.

2.4 SUMMARIES OF RELATED RESEARCHES :

The summary of studies obtained from selected reference literature relevant to this research has been given here.

Mehta (1989) initiated the study at M.Ed. level. The title was "The Study of Effectiveness of Teaching Aids in Mathematics in Primary Education". He designed tool in Mathematics of Std. 3 and 4 and studied the effectiveness of this teaching aid. This experiment was conducted on 97 students of Std. 3 and 87 students of Std. 5. The teacher made test was used as an instrument for both the experiments. He made use of non-accidentalization control group pre-test - post-test design. T-tests and co-variance analysis were used as analytical techniques. In both these experiments of Std. 3 and Std. 5 the teaching given by teaching aids was found effective in comparison to lecture method.

Dave (1992) conducted the study at M.Ed. level. His title was "The Study of Educational Games, Self-learning literature and Tape-slide programme as a main and supplementary teaching method in terms of achievement in mathematics of Std. 9. In this study, the educational games, self-learning literature and tape-slide programme was designed for the teaching of Set theory, geometry etc. In this study the number of students selected was 126 and counter balanced three group experimental design were used. He made use of teacher made unit test as an instrument. For information analysis T-test was used. The self-learning method as a teaching method was more effective in this study and the remaining two methods; the education games method and tape-slide method were found equally effective methods. More over, the educational games method as supplementary teaching method was found more effective and the remaining two methods; self learning method and tape-slide programme method were found equally effective methods.

Kundalia (2001) initiated the study at Ph.D. level and its title was "The design and effectiveness of geometrical instrument skill development

programme". In this study, he prepared geometrical instrument skill development programme in the form of directives and video films. 125 subjects (persons) were selected in this study. He used only two similar group post-test design. As an instrument the geometrical instrument skill test was designed. Mann Whit's U-test was used as analysis technique. Both the forms of geometrical instruments skill development programme prepared for research study were found effective.

Karia (2001) started the study at Ph.D. level. The title was "Effectiveness of Computer Assisted Learning as self-learning technique". In this study with the help of self-learning how much expert can one become was studied. Here by studying the acquired results of study it was found that programmed learning for boys and girls, and computer assisted learning were equally effective.

Ramanuj (2001) started the study at Ph.D. level and its title was "Effectiveness of Instrument based teaching of Mathematics'. Some instruments were designed in the study by the researcher. The teaching was given to the students with the help of these instruments. The result revealed that the instrument based teaching method was more effective.

2.5 REVIEW FROM RESEARCH SUMMARIES :

In previous studies Mehta (1989) had studied the effectiveness of teaching aid with lecture method. Dave (1992) made comparative study of the effectiveness of mathematical games, programmed learning and exercise method as supplementary teaching method. Patadia (1987) studied the effectiveness of teaching for effective learning. Dave (1997) studied the design and effectiveness of educational games, self learning literature and tape-slide programme as main and supplementary method.

In their previous studies, the study on subjects was taken up by Mehta (1989) at Std. 3 and 5. Dave (1992) at Std. 3, Patadia (1998) at secondary level, Dave (1997) at Std. 9 and Kundaliya (2001) at Std. 8 level.

In these studies 184 subjects (persons) of Mehta (1989), 60 of Dave (1992), 94 of Patadia (1987), 126 of Dave (1997) and 25 of Kundalia (2001) were selected.

In earlier studies Mehta (1989) used T-test analysis as analysis technique, Dave (1992) used co-discussion analysis, Patadia used percentile, mean, standard deviation, co-efficient of correlation and t-test, Dave (1997) used T-test and Kundaliya (2001) used T-test of Mann Whit as analysis technique.

In earlier studies, the teaching given by teaching aid in the study of Mehta (1989) as the main conclusion was found effective. In the study of Dave (1992) mathematical games as teaching method was found effective. In the study by Patadia (1987) the technique for effective learning was found effective. In the study by Dave (1997) self learning method as main teaching method and mathematical games as supplementary teaching method was found effective. In the study by Kundaliya (2001) both the forms of geometrical instrument skill development programme was found effective.

In earlier studies, Mehta (1989), Dave (1992), Dave (1997) and Patadia (1997) made use of teacher made test as an instrument whereas Kundaliya (2001) used geometrical instrument skill development test as an instrument.

2.6 FIFTH SURVEY OF RESEARCH IN EDUCATION (1988-1992) :

Studies based on computer assisted learning.

In this survey, the details of summary of three researches regarding computer assisted learning has been presented in the table as under :

According to Omkar Singh Deval in "The Fifth Survey of Research in Education", the teaching instruments and audio-visual equipments were famous only in their expository form in forties and fifties. It use was insignificant in class interaction. But in the period of last 15 years, due to development of modern instruments and technology the field of education has also benefited from it. The uses of TV, radio and other audio-visual media have increased very significantly in the field of education, and its feasibility has also proved to be significant. In between 1988-1992, 76 studies were conducted in terms of education technology in which 22 researches regarding audio-visual media and educational TV programmes, 7 researches regarding audio media and educational radio programmes, 23 researches regarding microteaching and other educational techniques, 4 researches regarding personnel system of instruction (PSI) and effective learning, 13 researches regarding programmed learning, other educational instruments and film strips, 4 researches regarding educational news graphics and 3 researches regarding computer assisted learning programme were conducted.

The researcher has presented the review through three research summaries regarding computer-assisted learning.

Singh, Ahluwalia and Verma tested as a part of their project work the effectiveness of computer assisted learning programme for mathematics in higher secondary school in terms of traditional teaching in which the achievement of the group studying through computer assisted learning programme was found significantly very high. Also the attitude of students of mathematics was found predicative. Moreover, the effect of sex on attitude towards acquired achievement and mathematics could not be seen.

Jayamani (1991) tested the effectiveness of adaptive model in teaching through computer assisted learning for physics of Std. 11 in which the

average of scores of experimental group was higher than that of the controlled group. Besides, the effect of sex was not seen on the achievement.

Ross (1992) examined the effectiveness of computer assisted learning software in terms of low-achiever students in which the computer assisted learning with or without teacher was more effective than the traditional teaching method. Moreover assistance of teacher along with computer assisted learning in low-achiever children was proved to be more effective.

Distinct features of the research :

The distinct features of this research other than earlier researches have been given here :

- ➢ The research was conducted on the subject of science at secondary level.
- ➢ In this research, experiment was conducted on students of Std. 8, 9 and 10.
- ➢ For the research the science confidence test was designed.
- ➢ Modern softwares of computer technology were used in the research.

CHAPTER - 3
STUDY DESIGN AND ITS BASES

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STUDY DESIGN AND ITS BASES

3.1 INTRODUCTORY:

The study design lies in the base of the study conducted by an researcher. Prior to this some problem arises in the mind of the researcher.

There is a popular principle of eminent psychologist, Mr. Kotler, in which he revealed in animals that they sometime get solution to their problem which is called “Flesh Of Insight” (Robin & Mc Neil 1981).

Similarly, such incidence occur to the researcher also. Before selecting a problem the researcher in order to reach to the problem, goes deep in many subjects the researcher is automatically attracted towards the matters of his interest and at last after studying many reference texts experiences a flash of some problem from within. We can take the example of Newton who while resting under a tree saw an apple falling downwards and his insight flashed as to “why did the apple come down?”. The problem emerging from these few words gave an extraordinary principle to physics and today we are able to send satellites in space by this very principle.

The researchers mostly reach to the selection of problem in such similar manner.

The researcher carries the selected problem to its solution and passes through chosen steps. The researcher plans in his mind as to how can he passes through the ladder of problem towards solution. This arrangement of the researcher is the study design to find the solution of a problem the researcher will select which sample to be used and how will he determine the sample, which instrument will he use, which information will he collect, how

will he analysis the acquired information and for many such other thing require pre-planning which is called the study design.

3.2 SCOPE: (Pervasion)

It means a group of subjects from which the sample is chosen for experiment, when researcher actually defines scope he determines, which kind and what kind of subjects, and then from them he selects a sample which reflects the quality of scope.

In this study, the effectiveness of teaching of science through computer at secondary level was tested and the units of science from Std. 8, 9 & 10at secondary level were selected. As a result, the students of Std. 8, 9 & 10 of secondary school of Gujarati medium of Gujarat State were included in the scope of the research.

3.3 SAMPLING:

Sample means a group of representative of subjects chosen for experiment.

The basis of simplicity and size of a sample lies in variable of the study, correctness of the result to be obtained, extend and difficulty of scope, number of controlled variables, method of information analysis and method of the study. The selected sample besides being the representative of the scope should be bias-free. Sampling saves time, energy and labor which can be taken for better use. As a result of this, deep and detailed studies can be conducted.

In experimental research selection of a smaller sample as compared to that in descriptive research does the work. Thus, it becomes difficult to find a sample for experiment research which represents the scope.

In the research of this kind of survey bigger samples can be obtained by information interview, questionnaire or other devices, such as, test. Once the test is tried the application of device is not necessary but the independent variable is used for long time. So the researcher however works with sample subjects for a long time the sample is smaller as compared to survey or other kind of researches.

(A) Probability Sample Methods:

1. Incidental Or Accidental Sample
2. Stratified Incidental Sample
3. Systematic Sample
4. Cluster Sample.

(B) Decisive Sampling Methods:

5. Concomitant Sample
6. Intentional Sample
7. Quota Sample.

(C) Other Sampling Methods:

8. Pair Sample
9. Dual Sample
10 Sequence Sample.
11. Multi Stage Sample.

(A) SCHOOL SELECTION:

For convenience in experiment, and co-operation from school management, Principals, Teachers and Students regarding the experiment two primary schools of Rajkot were chosen. These schools were chosen to get more cooperation suitable for selection of intentional sample. The schools were :

1. Shri Om Vidyalaya For Boys.
2. Shri Kanya Vidyalaya For Girls.

(B) GROUP SELECTION:

In the two schools, namely Shri Om Vidyalaya and Shri Kanya Vidyalaya selected for the research for implementation of the experiments, two groups were selected. While selecting the groups the understated things were taken into consideration.

There were two classes of Std. 8, 9, 10 in Shri Om Vidyalaya. All the students of both the classes were given notes / chits bearing their names and two groups of each class were formed. To determine the method of teaching, the notes were prepared bearing computer aided teaching method and lecture method in them. The chits decided the teaching method for each group. 'A' was assigned to the group, which was to given the teaching through computer aided teaching method and "B' to the group which was to given teaching, by lecture method.

Shri Kanya Vidyalaya had only one class of each standard. The student of each class of each Stds. Were asked to grab a chit accidentally and like this they were distributed in Group-1 and Group-2. After the formation of these groups, these groups were to be given teaching by which method was decided by lifting chits bearing computer aided teaching method and lecturer method written in them. After selection of the notes / chits the teaching method of each group was decided. 'A' was assigned to the group which was to be given teaching by computer aided teaching method and 'B' to the group for lecture method. Like this, with the help of accidentalization both the group of each class was selected.

This way, the experimental groups of each standard of both the schools were given teaching by computer aided teaching method and controlled group of each std. of each school given by lecture method. The information regarding the experiment conducted in this study, schools selected for that purpose, classes selected from the schools and the number of students of that class has been shown in table 3.1.

The number of boys present during the experiment from beginning to end is only shown in the table.

Table 3.1

The Sample Selected for Experiment

Experi-ment Sr. No.	***Name of School***	***Type of School In Terms of Sex***	***Std. and Class***	***Group***	***Strength of Students***
1.	Shri Om Vidyalaya	Boys	8A	Experimental	35
			8B	Controlled	35
2.	Shri Kanya Vidyalaya	Girls	8A	Experimental	35
			8B	Controlled	35
3.	Shri Om Vidyalaya	Boys	9A	Experimental	35
			9B	Controlled	35
4.	Shri Kanya Vidyalaya	Girls	9A	Experimental	35
			9B	Controlled	35
5.	Shri Om Vidyalaya	Boys	10A	Experimental	35
			10B	Controlled	35
6.	Shri Kanya Vidyalaya	Girls	9A	Experimental	35
			9B	Controlled	35

3.4 RESEARCH METHOD:

Generally in research study, the researcher uses and implements only one method out of historical explanatory or experimental research method.

The historical research method is used to derive general conclusions after solving the problem by scientific method for understanding present situation in context of past situation.

After knowing present situation on the basis of that, for future decisions and evaluating present situation with ideal situation any one of the explanatory method is used to solve the problem by scientific method.

If one variable affects the other, then the experimental research method is applied to examine the purpose of that effect.

In this research, the experimental method was implemented to examine the effectiveness of computer aided method of teaching science.

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3.4.1 EXPERIMENTAL RESEARCH:

Experimental research method is more pure and scientific than any other forms of researches. The amount of control, held on experiment research is more than that in explanatory researches. Thus, a systematic and logical relationship is established between the effect of factors and observation applied in the research. It is desired in the hypothesis in experimental research that some previous characteristic (independent variable) have relationship with other characteristics, event or effect in succession. To examine whether the perceived probabilities will emerge or not, the experimentalists gains control over all the probabilities and by applying the independent variable only and by studying the obtained results he/she can accept or reject the hypothesis in terms of applied variables.

The situation which is prepared for specific reasons by which the research principle or hypothesis is tested is experimental research.

3.4.2 CHARACTERISTIC OF EXPERIMENTAL RESEARCH:-

The experimental research in an arranged situation, gives appropriate result regarding the effect of specific method. To find an appropriate solution to a problem through experimental research these types of characteristics are considered essential.

3.4.2.1 CONTROL ON VARIABLES:-

During experiment on a dependent variable, some variables influences automatically so the fear of results of research being polluted arises. Therefore to maintain the reliability of the experiment, the researcher identifies such variables and controls them by different methods.

In this research the variables like standard, subject, content matter, medium of study, and class of student, teacher's teaching ability and school environment which affect on dependent variables were identified. It was tried by researcher to keep these variables in control.

3.4.2.2 THE IMPLEMENTATION OF INDEPENDENT VARIABLE:

The researcher identifies the variables which influence on dependent variables and after controlling them implements the independent variables. He studies the relationship between independent variable and dependent variables. The categories of independent variables are adaptable to the purposes of the experiment for the implementation of independent variables Appropriate method and programme suitable to the purpose is organized.

In this research the independent variable had two categories; computer aided teaching method and lecture method for the implementation of which the experimental work was organized.

3.4.2.3. MEASUREMENT OF DEPENDENT VARIABLE:

In this research the researcher examines the effect of independent variable in dependent variable. After applying independent variable the researcher measures dependent variable with the help of appropriate instrument and examines the effect on independent variable.

The dependent variables taken in this research were science achievement, science confidence and science retention.

3.4.2.4 REPETITION OF EXPERIMENT:

By repetition of experiment through same method on new subjects the validity expansion, generalization and reliability of the result is enhanced.

The repetition is also included in experimental research For this an experiment is conducted on girls of std. 8, 9, 10 of Mahatma Gandhi primary school. Similarly the experiment was also implemented on boys & std. 8, 9, 10 of Saurashtra Primary School.

3.5 EXPERIMENTAL DESIGN:

Experimental Design is an important aspect of experiment. Time, method, revision and validity of work can be determined by the experimental design. This way design is a blueprint of whole experiment for experimentalist. Which type of design is to be selected depends on the objectives of experiment.

3.5.1. PRE EXPERIMENTAL DESIGN:

There is no or very less control over other variables in this design. It fails to control the factors, which endanger the internal reliability of the experiment. This design, which has some separate elements of experimental design, is called pre-experimental design. It's types can be shown as under.

1. One study group
2. One group pretest-post test design
3. Two group design (as it is)

3.5.2. PARTLY EXPERIMENTAL DESIGN:-

In this design the factors which endanger the internal reliability of the experiment are being controlled However the emergence of prejudice could not be brought water control, this design is not as qualitative as complete – experimental design. But, this design is considered better than can be stated as under:

1. Unmatched controlled group pretest – post test design.
2. Counter balanced groups design
3. Periodical design.

3.5.3. PURE EXPERIMENTAL DESIGN:

In this experiment an attempt has been made to control the factors affecting the internal reliability of the experiment at most care is being taken according to the requirement of the design. No kind of compromise is to be entertained in this. This design is the best among all this types. The types can be shown as under:

1. Two groups incidental subjects post test design.
2. Two groups incident paired subjects only post test design.
3. Two incidental groups pretest. Post test design.

4. સોલોમાન અસ્મીકૃત Four groups design
5. Organic/ Factorial design:

3.5.4 EXPERIMENTAL DESIGN INTERNS OF THE SCREEN

In this research the effect of independent variable (teaching method) on dependant variable was to be tested. For this two groups each of std. 8, 9, 10 ware selected by incidentallization. One experimental group from class was taken. This way, among pure experimental design in the research "Two groups, accidental subjects only post tests were selected. The presentation of the design is as under:

Table 3.2

Two group, accidental subject, Only post- test design.

Group	Pre test	Dependent Variable	Post - test
Experimental Group	-	Computer assisted lecture method.	- Science achievement test - Science confidence inventory - Science achievement retest
Controlled Imp.	-	Lecture method	- Science Achievement test - Sci. confidence inventory - Science achievement retest.

3.6 PLANNING IN CONTEXT OF TEACHING METHODS:

The effect of independent variable on dependent variable was to be measured in this research. Independent variable was the teaching method. Two categories of independent variable were:

1. Computer assisted teaching method.
2. Lecture method.

To measure the effect of these two methods, experimental group for teaching aid based method and controlled group for lecture method were formed.

Certain units of Std. 8, 9, 10 were selected for teaching on both the groups. The selected units were as under:

Std. 8:

1. Change in weight when a solid substance submerges in liquid.
2. Experiment to understand the retraction of light in a glass prizum..
3. To describe the electromagnetism by figure.
4. To be aware of the world of

(i) Microorganisms

(ii) Bacteria

(iii) Fungi

(iv) Algae.

Std. 9:

1. To acquire understanding about modern periodic table
2. Experiment to find out specific heat of a substance (Copper)
3. Experiment to note time and change occurring in temperature of heat of boiling water after ice melts and the instruments use3d in the experiment.
4. Mixture of original colors.
5. To understand the internal structure of the human heart.
6. To understand the contribution of body in human excellence.

Class – 10

1. To obtain information about divisional extraction.
2. Ecosystem, food web.

3. Nitrogen cycle
4. Frots slotation process of raw material of sulphide mineral (forming system)
5. Experimental of preparation of methane gas
6. Experimental of preparation of ethane gas
7. Universe

(i) Solar system

(ii) Dopplar effect.

3.6.1 Perception of selected units to students through computer:

Students were taken to the computer laboratory. The software was installed in the system. The students were shown the slides coming on regarding topic. When the slide was shown the voice recorded was also heard by the students. The students thus were able to see what was spoken. This way the students were listening and also observing the topic taught to them. When it was necessary the repetition was done and the theoretical portion was drilled. After the satisfaction of the students the new topic was taught**.**

3.7 TOOLS :

The researcher thinks about which tools should be used to obtain the information during the constructions of study design. The selection of tools depends up to the type of problem and hypothesis. So the researcher selects the tools for study by examining the utility, reliability, validity and objectivity of the tool.

Details of answers to be used in the study are given as under:

1. Questionnaire
2. Interview

3. Rating scale
4. Check lists
5. Score cards.
6. Attitude scale
7. Oppinionaire
8. Observation
9. Sociometry
10. Psychological Tests

In the research the effect of independent variable; teaching technique on dependent variable (i) Science achievement (ii) Science confidence (iii) Science retention was measured. To examine this effect certain instrument used are shown as under:

1. Design of the instrument for measurement of Science achievement:

After the completion of teaching work in both, experimental groups and controlled groups of Std. 8, 9, 10 the test for measurement of science achievement was conducted. Three teacher made tests were designed for measurement of Science achievement in Std. 8, 9, 10 For each test total of 25 marks were decided.

2. Instrument for measurement of confidence in science:

On the basis of the mathematics confidence test designed by Sejpal D.K, the researcher designed science confidence measurement inventory.

CHAPTER - 4

THE USE OF SOFTWARE IN CLASSROOM

4.1 INTRODUCTORY

4.2 SELECTED EXPERIMENTS IN THE STUDY

CHAPTER - 4
THE USE OF SOFTWARE IN CLASSROOM

4.1 INTRODUCTORY :

This research was conducted to measure the effect of independent variable on dependent variable. In this research the independent variable of two categories : (1) Lecture method (2) Computer assisted teaching method; were determined. Three dependent variables : (1) Science achievement, (2) Science confidence and (3) Science retention; were determined. To test the effectiveness of the computer assisted teaching method, the software, which can be used in science subject at secondary level, was selected.

In this chapter the details about which selected unit of the software was taught and in that software how was the slide presented before the student, has been explained.

4.2 SELECTED EXPERIMENTS IN THE STUDY :

The selected experiments are presented in the computer slide form are as follows:

ઘોરણ – ૮

ઘન પદાર્થને પ્રવાહીમાં ધીમે ધીમે ડુબાડવામાં આવે ત્યારે તેના વજનમાં થતો ફેરફાર નકકી કરવાનો પ્રયોગ.

હેતું : ઘન પદાર્થને પ્રવાહીમાં ધીમે ધીમે ડુબાડવામાં આવે ત્યારે તેના વજનમાં થતો ફેરફાર નકકી કરવો.

સાધનસામગ્રી : ધાતુનો નળાકાર, સ્પ્રિંગકાંટો, પાણી ભરેલું સ્થળાંતર પાત્ર, કાચનો નળાકાર.

રીત : ધાતુનો નળાકાર લઈ તેની ત્રિજયા અને ઊંચાઈ નોંધો. નળાકારની ઊંચાઈ પર ત્રણ નિશાન કરો કે જેથી દરેક ભાગ મૂળ ઊંચાઈનો ૧/૪ હોય, નળાકારને સ્પ્રિંગકાંટા પર લટકાવી તેનું હવામાં વજન કરો. (W_1).

હવે નળાકારને પાણી ભરેલા સ્થળાંતર પાત્રમાં લટકાવો કે જેથી તેના કદનો ૧/૪ ભાગ પાણીમાં ડૂબે. સ્પિંગકાંટા પરનું વાચન નોંધો(W_2). આ જ પ્રમાણે નળાકારનો ૧/૨ ભાગ, ૩/૪ ભાગ અને પૂરોપૂરો ભાગ પાણીમાં ડૂબે તેમ લટકાવી દરેક વખતે સ્પ્રિંગકાંટા પરનું વાચન નોંધો.

અવલોકન : અવલોકનો નીચેના કોઠામાં નોંધો.

પદાર્થનું હવામાં વજન W_1

અવલોકન	નળાકારની ડૂબેલી લંબાઈ સેમીમાં (1)	નળાકારના ડૂબેલા ભાગનું કદ ઘન	સ્પ્રિંગકાંટા પર નોંધાતું વજન (W_1)	વજનમાં થતો દેખીતો ઘટાડો (W_1-W_2)
૧.				
૨.				
૩.				
૪.				

નિર્ણય : અવલોકન કોઠાના છેલ્લા કોલમ પરથી નકકી થાય છે કે નળાકાર જેમ જેમ પાણીમાં વધુ ડૂબતો જાય છે તેમ તેમ તેના વજનમાં થતો દેખીતો ઘટાડો વધતો જાય છે. એટલે કે પાણીનું તારકબળ વધતું જાય છે. નળાકાર પાણીમાં સંપૂર્ણ ડૂબી ગયા પછી વધારે ઊંડાઈએ ડુબાડવા છતાં વજનમાં થતા દેખીતા ઘટાડામાં કોઈ જ ફેરફાર થતો નથી.

ધોરણ–૮

સૂક્ષ્મ જીવો અને તેમનાં નિવાસસ્થાન

સૂક્ષ્મદર્શક વગર નરી આંખે ન જોઈ શકાતા સજીવોને સુક્ષ્મ જીવો કહે છે.

સુક્ષ્મ જીવોનાં નિવાસ સ્થાન : (૧) પાણીમાં – ગરમ પાણી, હિમશીતળ પાણી, મીઠું પાણી, ખારું પાણી (૨) જમીનમાં – રણની સૂકી જમીન, ભેજવાળી જમીન, કાદવ કીચડવાળી જમીન (૩) ધ્રુવીય પ્રદેશો અને ઊંચા પર્વતો પર (૪) હવામાં (૫) પ્રાણીઓ અને વનસ્પતિઓના શરીરમાં (૬) સજીવના મૃતદેહોમાં કે સજીવે ત્યાગ કરેલાં ઉત્સર્ગદ્રવ્યોમાં. આમ, સુક્ષ્મ જીવો સર્વત્ર વસે છે.

સુક્ષ્મ જીવોના કદ વિષે માહિતી : સુક્ષ્મ જીવો કદમાં ઘણાં જ નાનાં છે. તેમને જોવા માટે સુક્ષ્મદર્શક અથવા ઈલેકટ્રોન માઈક્રોસ્કોપની જરૂર પડે છે. એકકોષી અમીબા કરતાં જીવાણું કદમાં ત્રણ લાખ ગણાં નાનાં છે.

➪ જીવાણુંઓ :

સામાન્યત : જીવાણુંની વૃદ્ધિ બહુ જ ઝડપી છે. સ્યુડોમોનાસ પ્રકારના જીવાણુ લગભગ દર ૯.૫ મીનીટે બમણા થતા જાય છે. ઈશેરિશિયા કોલી જીવાણુ, જે માનવીના આંતરડાના છેડા તરફના ભાગમાં હોય છે, લગભગ દર ૨૦ મિનીટે બમણા થાય છે. ટીબી (ક્ષય) અને કૃષ્ઠરોગના જીવાણુની વૃદ્ધિ પ્રમાણમાં ઘણી જ ધીમી છે. (ટીબી (ક્ષય) ના જીવાણુ લગભગ ૧૬ કલાકે બમણા થાય છે.) જીવાણુના વિકાસ માટે ભેજવાળું અને હૂંફાળું વાતાવરણ અનુકૂળ છે. ખૂબજ નીચું કે ખૂબજ ઊંચુ તાપમાન જીવાણુના વિકાસ માટે પ્રતિકૂળ છે.

(જીવાણુ દ્વારા રોગો થાય છે તેવું સૌ પ્રથમ રોબર્ટ કોકસ નામના જર્મન વિજ્ઞાનીએ ઈ.સ. ૧૮૭૬ માં સાબિત કર્યુ હતું.)

➪ ફૂગ :

બગડી ગયેલા ફળ, વાસી પાંઉ, અથાણાં કે જામની બરણીમાં ભૂરા – લીલા કે સફેદ મખમલ જેવા પોચા અને ખૂબ જ શાખાયુકત તાંતણા જોવા મળે છે તેને ફૂગ કહે છે. ફુગના મુખ્ય બે પ્રકાર છે (૧) યીસ્ટ અને (૨) મોલ્ડ

ફુગના ફાયદા : (૧) બેકરીમાં પાંઉ અને કેક બનાવવા ફુગ ઉપયોગી છે. (૨) જવમાંથી બિઅર, ફળોના રસમાંથી દારૂ, ચોખા અને દાળના લોટના મિશ્રણમાંથી ઢોકળાં, ઈડલી અને ઢોંસા બનાવવા પીસ્ટ વપરાય છે. (૩) તે પનીર બનાવવા ઉપયોગી છે. (૪) બિલાડીના ટોપ જેવી ફુગ ખોરાક તરીકે ઉપયોગી છે. (૫) પેનિસિલીન જેવાં એન્ટિબાયોટિક ઔષધો ફુગમાંથી બનાવવામાં આવે છે.

ફુગના ગેરફાયદા : (૧) ફુગને લીધે ખોરાક બગડે છે. (૨) ફુગને લીધે મકાઈ, ઘઉ તથા બટાટા વગેરે પાકને રોગ લાગુ પડે છે. (૩) કપડાં, ચામડું, લાકડું વગેરે ફુગ લાગવાથી તરત કામમાં લઈ શકાતાં નથી. (૪) કેટલીક પ્રકારની ફુગને લીધે દરાજ, ખરજવું વગેરે ચામડીના રોગો થાય છે.

ફુગના વિવિધ પ્રકારો : (૧) પાંઉ પર જોવા મળતી ફુગ (મ્યૂકર) (૨) એસ્પરજીલસ (૩) પેનિસિલિયમ (૪) યીસ્ટ અને (૫) બિલાડીનો ટોપ.

➪ લીલ :

લીલ વિવિધ પ્રકારની હોય છે. એકકોષીય લીલ અને બહુકોષીય લીલ. વિવિધ પ્રકારના રંજકદ્રવ્યો ધરાવતી લીલ જેવી કે લાલ, બદામી, નીલહરિત, લીલી વગેરે. ફયૂકસ (સરગાસમ) બદામી રંગની લીલ છે. સ્પાયરોગાયરા લીલા રંગની છે. ઓસિલેટોરિયા નીલહરિત રંગની છે. ઉપરાંત નોસ્ટોક, એનાબીના વગેરે વિવિધ પ્રકારની લીલ છે.

ધોરણ – ૮

મોરથૂથૂના દ્રાવણમાંથી વિદ્યુત પ્રવાહ પસાર કરતા થતી અસરો ચકાસવાનો પ્રયોગ

હેતું : મોરથૂથૂના દ્રાવણમાંથી વિદ્યુત પ્રવાહ પસાર કરતા થતી અસર સમજવી.

સાધન સામગ્રી : મોરથૂથૂના દ્રાવણ, તાંબાની પટી, કાર્બનનો સળિયો, કાચનું પાત્ર, બેટરી, વાહક તાર.

રીત : કાચના પાત્રમાં મોરથૂથૂનું દ્રાવણ લો. તેમાં કાર્બનનો સળિયો અને તાંબાની પટી મૂકો બેટરીના શ્રાવણ ધ્રુવ સામે કાર્બનના સળિયાનું અને ઘન ધ્રુવ સામે તાંબાની પટીનું જોડાણ કરો. કાર્બનનો સળિયો અને તાંબાની પટી એકબીજાને સ્પર્શે નહી તેની કાળજી રાખો. આકૃતિમાં બતાવ્યા પ્રમાણે સ્વિચ દાબી વિદ્યુત પરિચય પૂર્ણ કરો. શું થાય છે તેનું અવલોકન કરો.

અવલોકન :

કાર્બનના સળિયા પર તાબાનું સ્તર છવાયેલું દેખાશે.

નિર્ણય :

મોરથૂથૂના દ્રાવણમાંથી વિદ્યુત પસાર કરતા તેમાંથી તાંબુ અલગ પડી કાર્બનના સળિયા પર છવાય છે.

ધોરણ–૮

કાચના લંબધનમાં થતા પ્રકાશના વક્રીભવનને સમજવા માટેનો પ્રયોગ

હેતુ : કાચના લંબધનમાં થતા પ્રકાશના વક્રીભવનની ઘટના સમજવી.

સાધન સામગ્રી : કાચનો લંબધન, સફેદ કાગળ, ડ્રાઈગ બોર્ડ, ટાંકણીઓ, કંપાસ પેટી.

રીત : ડ્રોઈંગ બોર્ડપર સફેદ કાગળ મૂકી તેના પર કાચનો લંબધન ગોઠવો. પેન્સિલ વડે લંબધનની PQRS સપાટી આંકી લો PQ ને લંબ ન હોય તેવી રેખા AB દોરો, જે PQ ને B માં છેદે. રેખા AB પર બે ટાંકણીઓ P_1 અને P_2 ઉભી ખોસો.હવે લંબધનની બીજી બાજુ RS તરફથી જોઈ ટાંકણીઓ P_3 અને P_4 એવી રીતે ખોસો કે જેથી P_1 અને P_2 નાં કાચમાં દેખાતાં પ્રતિબિંબ અને ટાંકણીઓ P_3 અને P_4 એક સીધી લીટીમાં દેખાય. કાચનો લંબધન તથા ટાંકણીઓ P_3 અને P_4 ઉપાડી લો. ટાંકણીઓ P_3 અને P_4 થી પડેલાં છિદ્રો જોડી રેખા CD દોરો જે RS ને C માં મળે. B અને C જોડો. B અને C આગળ લંબધનની આંકેલી સપાટીને લંબરેખાઓ અનુક્રમે MN અને M 'N' દોરો.

અવલોકન : આપાતકોણ MBA કરતાં વક્રીભવનકોણ NBC નાનો છે.

નિર્ણય : પ્રકાશનું કિરણ પાતળા માધ્યમમાંથી ઘટ્ટ માધ્યમમાં જતાં લંબ તરફ વળે છે. આમ, વક્રીભવનને લીધે પ્રકાશના કિરણનો માર્ગબદલાય છે.

ધોરણ – ૯

આધુનિક આવર્ત કોષ્ટક

આધુનિક આવર્ત કોષ્ટકમાં તત્વોનું વર્ગીકરણ તેમના પરમાણુક્રમાંકને આધારે કરવામાં આવ્યું છે.

આવર્તમાં એક તત્વથી બીજા તત્વનો પરમાણુક્રમાંક ક્રમશ : એકથી વધે છે. એક તત્વ બીજા તત્વના પરમાણુંભારાંકમાં ક્રમશ : વધારો અનિયમિત છે. આથી આધુનિક આવર્ત કોષ્ટક તત્વોના પરમાણુંક્રમાંક અનુસાર ગોઠવણી વધુ તાર્કિક છે.

આધુનિક આવર્ત કોષ્ટકનાં આવર્તો :

(૧) પહેલું આવર્ત સૌથી નાનું છે. તેમાં ફકત બે જ તત્વો – હાઈડ્રોજન અને હિલિયન છે.

(૨) બીજા અને ત્રીજા આવર્તો લઘુ આવર્તો છે. તે દરેકમાં ૮ તત્વો છે.

(૩) ચોથા અને પાંચમા આવર્તો દીર્ઘ આવર્તો છે. આ દરેક આવર્તમાં ૧૮ તત્વો છે.

(૪) છઠું આવર્ત સૌથી વધુ દીર્ઘ છે. તેમાં ૩૨ તત્વો છે, જે પૈકી ૧૪ તત્વો વિરલ ધાતુ વર્ગનાં છે.

(૫) સાતમું આવર્ત અપૂર્ણ છે.

નોંધ: ૨,૮,૮,૧૮,૧૮,૩૨ તત્વોનો આ ક્રમ જુદાં જુદાં તત્વોના પરમાણુઓના ઈલેકટ્રોન સંરચનાનો પર નિર્દેશ કરે છે.

ધોરણ – ૯

પદાર્થની વિશિષ્ટ ઉષ્મા કરવાનો પ્રયોગ

હેતુ : પદાર્થ (તાંબુ) ની વિશિષ્ટ ઉષ્મા શોધવી.

સાધન સામગ્રી : તાંબાનું પાત્ર, પાણી, થરમોમીટર, કાચનો સળિયો, અવાહક આવરણ, લાકડાનું પાત્ર, બે કાણાંવાળુ લાકડાનું ઢાંકણ, વૈજ્ઞાનિક ત્રાજવું વગેરે.

રીત : વૈજ્ઞાનિક ત્રાજવાથી મદદથી તાંબાના પાત્રનું દળ (m) શોધો. તાંબાના પાત્રના સંસર્ગમાં થરમોમીટર રાખી તેનું શરૂઆતનું તાપમાન (t_1) નોંધો. કાચના બીકરમાં 500 મીલી (500 ગ્રામ) પાણી લઈને તેને લગભગ 80° C થી 90° C સુધી ગરમ કરો. ગરમ પાણીનું તાપમાન (t_2) નોંધો. આકૃતિમાં બતાવ્યા મુજબ ગોઠવેલા તાંબાના પાત્રમાં આ ગરમ પાણી રેડો. પાત્ર પર બે કાણાંવાળું લાકડાનું ઢાંકણ ગોઠવો. પાણીને કાચના સળિયા વડે વખતો વખત હલાવતા રહો. ગરમ પાણી તાંબાના પાત્રને ગરમી આપશે. થરમોમીટરમાં તાપમાન જોતા રહો. જયારે થરમોમિટરમાં પારો નીચે ઉતરતો અટકી જાય ત્યારે તાપમાન (t_3) નોંધો. આ તાપમાન તાંબાના પાત્ર અને તેમાં રેડેલા પાણીનું અંતિમ તાપમાન હશે.

બરફ પીગળી બનેલું પાણી ઉકળે ત્યાં સુધી ગરમી આપતાં તાપમાનમાં થતા ફેરફારની સમય સાથે નોંધ કરવી.

બે લિટરની ગુંજાશવાળા એક સખત કાચના બીકરમાં આશરે1 કિગ્રા બરફનો ભૂકો નાખો. તેમાં સેલ્સિયસ થરમોમીટર મૂકી બરફનું ઉષ્ણતામાન નોંધો જે 0°C હશે. આકૃતિમાં બતાવ્યા મુજબ બીકરને ધીમે તાપે ગરમ કરો. બીકરમાંના બરફને ભેળક વડે સતત હલાવતા રહો. દર બે કે ત્રણ મિનિટે તાપમાન નોંધતા રહો. બધો બરફ ન પીગળે ત્યાં સુધી તાપમાન 0°C રહેશે. બરફ પીગળી ગયા પછી તાપમાન ધીમે ધીમે વધશે અને પાણી ઉકળે ત્યારે તાપમાન 100°C થશે. ઉકળતા પાણીને ગરમી આપવાનું ચાલુ રાખશો તો પણ તાપમાન વધશે નહિ.

મૂળ રંગોની મેળવણી :

લાલ, લીલો અને ભૂરો આ ત્રણ મૂળ રંગોને સંયોજી મૂળ રંગો કહે છે.

ત્રણ ટોર્ચ લઈ એકના કાચ પર લાલ, બીજીના કાચ પર લીલો અને ત્રીજીના કાચ પર ભૂરા રંગનો પારદર્શક કાગળ બાંધો. અંધારા ઓરડામાં સફેદ પડદા પર આ ત્રણે ટોર્ચમાંથી પ્રકાશ એવી રીતે પાડવા દો કે જેથી ત્રણેની કિરણાવલી એકબીજા પર આપાત થાય.

લાલ, લીલો અને ભૂરો આ ત્રણમાંથી બે રંગોની મેળવણીથી મળતા રંગો :

લાલ + ભુરો – મેજેન્ટા (M – ઘેરો જાંબુડિયો લાલ)

ભૂરો + લીલો – સાયેન (C – લાલનો પુરવણી – મોરપીછ)

લાલ + લીલો – પીળો (Y)

આ પ્રમાણે મૂળ રંગોની યોગ્ય પ્રમાણમાં મેળવણી કરીને નવા રંગો મેળવી શકાય છે.

ધોરણ – ૯

માનવ હૃદયની આંતરીક રચના

માનવશરીરની છાતીના પોલાણમાં આવેલું હૃદય સ્નાયુઓનું બનેલું એક માંસલ અંગ છે. તે સમયગતિક સંકોચન (આકુંચન) અને શિથિલન (વિસ્તરણ) દર્શાવતું ખૂબ જ મહત્વનું અંગ છે. તે ચાર ખંડોનું બનેલું છે. ઉપલા બે ખંડોને કર્ણક અને નીચલા બે ખંડોને ક્ષેપક કહે છે. હૃદયની મધ્યમાં એક ઉભો માંસલ પડદો હોય છે, જે બંને કર્ણકોને તેમજ બંને ક્ષેપકોને એકબીજાથી જુદા પાડે છે. જમણા કર્ણક અને જમણા ક્ષેપક વચ્ચે તેમજ ડાબા કર્ણક અને ડાબા ક્ષેપક વચ્ચે આડો પડદો હોય છે. ડાબું કર્ણક ડાબા ક્ષેપક સાથે વાલ્વયુકત છિદ્ર સંબંધ ધરાવે છે. આ વાલ્વને દ્વિદલ વાલ્વ કહે છે. જમણું કર્ણક જમણા ક્ષેપક સાથે ત્રિદલ વાલ્વયુકત છિદ્ર સંબંધ ધરાવે છે.

જમણા કર્ણકમાં એક ઉર્ધ્વમહાશિરા અને એક અધ : મહાશિરા ખૂલે છે. આ મહાશિરાઓ જમણા કર્ણકમાં બે મોટાં છિદ્રો ખૂલે છે. આ છિદ્રો વાલ્વયુકત છે. ડાબા કર્ણકમાં ફેફસામાંથી રુધિર લાવતી ફુપ્સુસ શિરાઓ ખૂલે છે.

જમણા ક્ષેપકમાંથી એક મોટી ફુપ્ફુસ ધમની નીકળે છે, જયારે ડાબા ક્ષેપકમાંથી મહાધમની નીકળે છે. હૃદયની સમગ્ર બાહયસપાટી પરિહૃદાવણ તરીકે ઓળખાતા પાતળા અને બેવડા પડથી ઘેરાયેલી હોય છે.

ધોરણ–૧૦

પેટ્રોલિયમના વિભાનીય નિસ્યંદન માહિતી

પેટ્રોલિયમનાં વિવિધ ઘટકોનાં ઉત્કલનબિંદુ જુદાં જુદાં હોવાથી તેનું વિશુદ્ધીકરણ વિભાગીય નિસ્યંદન પદ્ધતિથી થાય છે. આ ક્રિયા માટે વિભાગીય નિસ્યંદન ટાવરનો ઉપયોગ થાય છે.

પેટ્રોલિયમને હવાની ગેરહાજરીમાં 450° સે થી ઊંચા તાપમાને ગરમ કરી વિભાગીય નિસ્યંદન ટાવરમાં દાખલ કરવામાં આવે છે. આ તાપમાને ડામર (આસ્ફાલ્ટ) સિવાયના બધા જ ઘટકોની બાષ્પ બને છે. બાષ્પ ટાવરમાં ઉપર જતા ઠંડી પડે છે. જે ઘટકનું ઉત્કલનબિંદુ સૌથી વધારે હોય તેનું પ્રથમ પ્રવાહીકરણ થઈ નીચેના ભાગમાં છુટું પડે છે. નીચેથી ઉપર જતા જુદા જુદા ઘટકો તેમના ઉત્કલનબિંદુના ઉતરતા ક્રમમાં છુટા પડે છે. બાકી રહેલા વાયુઓ ટાવરના ઉપરના ભાગમાંથી બહાર નીકળે છે.

પેટ્રોલિયમના વિભાગીય નિસ્યંદન દ્વારા મળતી અગત્યની પેદાશો નીચે મુજબ છે :

પેટ્રોલિયમ વાયુઓ, પેટ્રોલ, નેપ્થા, કેરોસીન, ડિઝલ, ઊંજણ તેલ, બળતણ તેલ અને ડામર.

ધોરણ – ૧૦
મિથેન વાયુ બનાવવાનો પ્રયોગ

સાધનો : સખત કાચની કસનળી, એક કાણાવાળો બૂચ, વિમોચન નળી, વાયુપાત્રો, કાચનું પાત્ર, બી–હાઈવ શેલ્ફ, બર્નર સ્ટેન્ડ.

પદાર્થો : સોડીયમ એસિટેટ, સોડા લાઈમ, પાણી.

રીત : સખત કાચની કસનળીમાં 2 ગ્રામ સોડિયમ એસિટેટ અને 2 ગ્રામ સોડા લાઈમનું મિશ્રણ સખત કાચની કસનળીને બર્નર વડે ગરમ કરો.
સોડિયમ એસિટેટ અને સોડા લાઈમમાંના સોડિયમ હાઈડ્રોકસાઈડ વચ્ચે રાસાયણિક પ્રક્રિયા મિથેન વાયુ મુકત થાય છે.
પ્રક્રિયાનું સમીકરણ : $CH_3COONA + NaOH \rightarrow CH_4 + Na_2 CO_3$
ઉત્પન્ન થયેલા મિથેન વાયુને પાણીના અધ : સ્થાનાંતરથી વાયુપાત્રોમાં એકઠો કરવામાં આવે છે.

મિથેનના ગુણધર્મો : (૧) તે પાણીમાં અદ્રાવ્યો છે. (૨) તે રંગહીન અને ગંધહીન વાયુ છે. (૩) તે હવા કરતાં હલકો છે. (૪) તે દહનશીલ વાયુ છે. (૫) હવામાં સળગાવતાં ભૂરી જયોતથી સળગી કાર્બન ડાયોકસાઈડ અને પાણી ઉત્પન્ન કરે છ. આ પ્રક્રિયા ઉષ્માક્ષેપક પ્રક્રિયા છે.

➪ ઈથેન વાયુ બનાવવાનો પ્રયોગ :

સાધનો : સખત કાચની કસનળી, એક કાણાવાળો બૂચ, વિમોચન નળી, વાયુપાત્રો, કાચનું પાત્ર, બી–હાઈવ શેલ્ફ, બર્નર, સ્ટેન્ડ.
રીત : થોડી રેતી લઈ તેમાં થોડું કેરોસીન મિશ્ર કરો (રેતીને કેરોસીનથી ભીજવો). આ મિશ્રણ સખત કાચની કસનળીમાં લો. કસનળી આડી રાખી કસનળીના આગળના ભાગમાં ચીની માટી અથવા પોર્સેલિનના નાના ટુકડા ગોઠવી આકૃતિમાં દર્શાવ્યા મુજબ સાધનો ગોઠવો. પ્રથમ ચીની માટી લાલચોળ થાય ત્યાં સુધી બર્નર વડે ગરમ કરો. ત્યાર પછી કેરોસીન ધરાવતી રેતીને ગરમ કરો. બર્નરની જયોત વડે વારાફરતી ચીની માટી

અને કેરોસીન ધરાવતી રેતીને ઝડપથી ગરમ કરતા રહો. કેરોસીન – (હાઈડ્રોકાર્બન) નું વિભંજન થઈ ઈથીન વાયુ મુકત થશે (ઈથીન વાયુ પાણીના અધ : સ્થાનાંતરથી વાયુપાત્રમાં એકઠો કરવામાં આવે છે.)

ઈથેનના ગુણધર્મો : (૧) તે પાણીમાં અદ્રાવ્ય છે. (૨) તે રંગહીન અને ગંધહીન વાયુ છે. (૩) તે દહશનીલ વાયુ છે. (૪) હવામાં સળગાવતાં મેશવાળી જ્યોત સાથે બળે છે. (૫) ઈથેન વાયુમાં બ્રોમિન ઉમેરી હલાવતાં બ્રોમિનનો બદામી રંગ દૂર થાય છે. (૬) ઈથેન વાયુમાં મંદ એસિડિક પોટેશિયમ પરમેગેનેટનું દ્રાવણ ઉમેરી હલાવતા દ્રાવણ રંગહીન બને છે.

ઘોરણ – ૧૦

બ્રહ્માંડની ઉત્પતિ વિશેની માન્યતાઓ

ઈ.સ. ૧૯૨૦ માં એડવિન હબલ નામના ખગોળવિજ્ઞાનીએ પોતે નોંધેલાં અવલોકનો પરથી દર્શાવ્યું કે ગેલેક્સીઓ સ્થિર નથી, પરંતુ તેઓ એકબીજાથી ઝડપથી દૂર જઈ રહી છે. આમ, બ્રહ્માંડ, અવિરણપણે વિસ્તરી રહયું છે.

ખગોળશાસ્ત્રીઓના મત મુજબ ગેલેક્સીઓ એકબીજીથી દૂર થઈ રહી હોવાનું કારણ ભૂતકાળમાં બનેલી કોઈ ઘટના હોવી જોઈએ. આ ઘટના એટલે વિસ્ફોટ. ભૂતકાળમાં મહાવિસ્ફોટને કારણે ગેલેક્સીઓ એકબીજાથી દૂર ધકેલાઈ છે.

ગેલેક્સીઓ એકબીજાથી દૂરજાય છે તેના કરતા ઉલ્ટી પરિસ્થિતિ વિચારીએ (એટલે કે એકબીજાની નજીક આવતી જાય છે), તો આશરે 15×10^9 વર્ષમાં આખું બ્રહ્માંડ એક બિંદુવત બની જાય. આનો અર્થએ થયો કે15×10^9 વર્ષ પહેલાં વિસ્ફોટ થયો હોવો જોઈએ અને ગેલેક્સીઓ એકબીજાથી દૂર ધકેલાઈને આજની સ્થિતિમાં પહોંચી છે.

સૂર્યમંડળ : સૂર્ય, સૂર્યની આસપાસ ફરતા ગ્રહો, લઘુગ્રહો તથા ગ્રહોની આસપાસ ફરતા ઉપગ્રહોના બનેલા સમૂહને સૂર્યમંડળ કહે છે.

સૂર્યમંડળની ઉત્પતિ આશરે 4.5×10^9 વર્ષ પહેલા થઈ હોવાનું મનાય છે. તે સમયે સૂર્યની આજુબાજુ તકતી આકારનું વાયુનું વાદળ સર્જાયેલું હતું. આ વાયુ સંકોચન પામતો ગયો જેમાંથી નાના ખડકો બન્યા. આ નાના ખડકો (સુક્ષ્મ ઉપગ્રહો) સતત એકબીજા સાથે અથડાયા કરતા. અથડામણ દરમ્યાન તેઓ તૂટતા અને ફરી પાછા જોડાઈને મોટા ખડક બનતા. મોટા નાના ખડકોને આકર્ષીને વધારે મોટા ખડકમાં ફેરવાતાં ક્રમશ : આ ખડકો ગ્રહોના કદના બન્યા. આવી પ્રક્રિયાને કારણે સૂર્યમંડળનું નિર્માણ થયું.

સૂર્યમંડળ એ મંદાકિની ગેલેક્સીનો એક ભાગ છે.

સૂર્યમંડળમાં સૂર્ય, સૂર્યની આસપાસ ફરતા ગ્રહો, લઘુ ગ્રહો તથા ગ્રહોની આસપાસ ફરતા ઉપગ્રહનોનો સમાવેશ થાય છે.

સૂર્યમંડળમાંના નવ ગ્રહો સૂર્યને કેન્દ્રસ્થાને રાખી જુદી જુદી કક્ષાઓમાં સૂર્યની આસપાસ પરિભ્રમણ કરે છે.

ડોપ્લર અસર : સાપેક્ષ ગતિ દરમ્યાન અવલોકનકાર અને તરંગ ઉદ્‌ગમ (ધ્વનિ – ઉત્પાદક) વચ્ચેનું અંતર ઘટતું હોય, તો અવલોકનકાર ધ્વનીની મૂળ આવૃતિ કરતાં વધારે

આવૃતિનો અનુભવ કરે છે. જો આ અંતર વધતું હોય તો અવલોકનકાર તરંગની મૂળ આવૃતિ કરતાં ઓછી આવૃતિનો અનુભવ કરે છે.

અવલોકનકાર અને સ્થિર માધ્યમમાં તરંગ ઉદ્‌ગમ (ધ્વનિ – ઉત્પાદક) વચ્ચેની સાપેક્ષ ગતિને કારણે ધ્વનિની આવૃતિમાં આભાસી ફેરફાર થયેલો જણાય છે. ઘટનાને ડોપ્લર અસર કહે છે. પ્રકાશનું સંચરણ પણ તરંગરૂપે થતું હોવાથી પ્રકાશની બાબતમાં પણ ડોપ્લર અસર સંભવે છે.

ધોરણ – ૧૦

અન્નજાળ

નિવસનતંત્રમાં વનસ્પતિત્યાહારી પ્રાણીઓના પાયા પર રચાયેલી ખોરાક માટે ઉતરોતર પરસ્પર આધાર રાખતાં પ્રાણીઓના સમૂહની પરસ્પર સંકળાયેલી શ્રેણીને અન્નજળ કહેવાય છે.

અથવા

વિવિધ નિવસનતંત્રમાં આહારને લક્ષમાં રાખી રચાતી અને પરસ્પર સંકળાયેલી આહાર શૃંખલાઓને અન્નજાળ કહે છે.

➪ કુદરતમાં નાઈટ્રોજનચક્ર :

વાતાવરણમાં નાઈટ્રોજનનું પ્રમાણ લગભગ ૭૮% જેટલું હોય છે. સજીવો પ્રત્યક્ષ રીતે આ નાઈટ્રોજનનો સીધો ઉપયોગ કરી શકતા નથી. વનસ્પતિ જમીનમાંથી નાઈટ્રોજનનું શોષણ એમોનિયમ નાઈટ્રાઈટ અને નાઈટ્રેટ જેવા ક્ષારોસ્વરૂપે પાણીના માધ્યમ દ્વારા કરે છે.

કઠોળ વર્ગની વનસ્પતિઓ, મગફળી તથા શિમ્બી કુળની અન્ય વનસ્પતિઓની મૂળ ગંડિકાઓમાં રહેલા રાઈઝોબિયમ બેકેટેરિયા અને અન્ય મૂળમાં રહેલી નોસ્ટોક અને એનાબીના નામની નીલહરિત લીલ હવામાના મુકત નાઈટ્રોજનનું જમીનમાં નાઈટ્રોજનયુકત ક્ષારોમાં રૂપાંચર કરી સ્થાપન કરે છે. વનસ્પતિ અને પ્રાણીઓના મૃતદેહોમાંથી તેમજ તેમણે ઉત્પન્ન કરેલા મળ અને અન્ય ત્યકત દ્રવ્યોમાંથી પણ જમીનમાં રહેલા સુક્ષ્મ જીવો એમોનિયા તથા એમોનિયમ નાઈટ્રાઈટ અને નાઈટ્રેટ જેવા ક્ષાર પ્રાપ્ત કરી આપે છે. વનસ્પતિ આવા નાઈટ્રોજન યુકત ક્ષારોનું શોષણ કરી તેમાંથી પ્રોટીનનું સંશ્લેષણ કરે છે.

પ્રાણીઓ વનસ્પતિનું ભક્ષણ કરીને તેમાંથી જરૂરી નાઈટ્રોજન મેળવે છે, જે પ્રાણીઓના શરીરના પ્રોટીનના બંધારણ માટે વપરાય છે. પ્રાણીઓ જયારે મૃત્યુ પામે છે ત્યારે જમીનમાં રહેલા વિઘટક અને રૂપાંતર સુક્ષ્મ જીવો તેમના પ્રોટીનનું વિઘટન કરી નાઈટ્રોજનના સરળ ક્ષારો મુકત કરે છે. જમીનમાં રહેલાં કેટલાંક જીવાણુઓ

નાઈટ્રોજનયુકત પદાર્થોમાંથી નાઈટ્રોજન છુટો પાડે છે. આમ, નાઈટ્રોજનચક્ર ચાલ્યા કરે છે.

➪ નિવસન તંત્ર

નિવસનતંત્ર સજીવ અને નિર્જીવ ઘટકોનું બનેલું હોય છે. તળાવ, નદી, સરોવર, દરિયો જેવાં જલીય નિવસનતંત્રો અને તૃણભૂમિ, જંગલ, રણ જેવાં સ્થળ જ નિવસનંતત્રો છે. આ ઉપરાંત વાડી (બાગાયત), ખેતર, માછલીઘર જેવાં કૃત્રિમ નિવસનતંત્રો પણ છે. નિવસનંતત્રમાં જૈવિક તેમજ અજૈવિક ઘટકો હોય છે. જૈવિક ઘટકોમાં ઉત્પાદકો (લીલી વનસ્પતિ), ઉપભોકતા (તૃણાહારી, માંસાહારી, સર્વભક્ષી), વિઘટકો અને રૂપાંતરકો (પરોપજીવી) મૃતોપજીવી નો સમાવેશ થાય છે. અજૈવિક ઘટકોમાં સૂર્યપ્રકાશ, તાપમાન, વાયુઓ, પાણી, જમીન અને પાણીમાંના ક્ષારો, ખડકો, વાતાવરણમાં ભેજ વગેરેનો સમાવેશ થાય છે.

➪ સલ્ફાઈડ ખનીજોવાળી કાચી ધાતુનું સંકેન્દ્રણ (ફીણ ઉત્પ્લવન પદ્ધતિ) :

સલ્ફાઈડ ખનીજોવાળી કાચી ધાતુઓ (જેવી કે કોપર, લેડ, ઝિંકની સલ્ફાઈડયુકત કાચી ધાતુઓ) ના સંકેન્દ્રણ માટે ફીણ ઉત્પ્લવન પદ્ધતિનો થાય છે. આ પદ્ધતિમાં એક મોટા પાત્રમાં પાણી અને ટર્પેન્ટાઈનનું મિશ્રણ લઈ કાચી ધાતુનો બારીક પાઉડર નાખવામાં આવે છે. કાચી ધાતુમાના સલ્ફાઈડના કણો ટર્પેન્ટાઈનનું ભીજાય છે, જયારે માટી અને રેતીના કણો ટર્પેન્ટાઈનથી ભીજાતા નથી. આ મિશ્રણમાં એક નળી મારફતે દબાણથી હવા પસાર કરવામાં આવે છે. માટી, રેતી વગેરેના કણો પાણી વડે ભીજાઈ પાત્રના તળીયે બેસે છે. સલ્ફાઈડ ખનીજવાળા ફીણને બીજા પાત્રમાં લઈ પાણીથી ધોવામાં આવે છે. આમ કરવાથી કાચી ધાતુનું સંકેન્દ્રણ થાય છે અને ખનીજમાંથી માટી, રેતી વગેરે દૂર થાય છે.

CHAPTER - 5
INFORMATION ANALYSIS AND INTERPRETATION

CHAPTER - 5
INFORMATION ANALYSIS AND INTERPRETATION

5.1 INTRODUCTORY :

This experimental research is regarding the effect of independent variable on dependent variable. As an independent variable, the teaching method had two categories; Lecture method and Computer aided teaching method. As dependent variables; Science achievement, science confidence and science retention were covered. It was to be examined that if using computer aided teaching method the science achievement , science confidence and science retention of the students can be affected or not.

5.2 EXPERIMENTS CONDUCTED :

In this study two group experimental research design was used. The study was to be conducted in context of Std. 8, 9, 10 and boys and girls. So total number of six experiments were taken up :

Experiment - 1 conducted on boys of class - 8

Experiment - 2 conducted on girls of class - 8

Experiment - 3 conducted on boys of class - 9

Experiment - 4 conducted on girls of class - 9

Experiment - 5 conducted on boys of class - 10

Experiment - 6 conducted on girls of class - 10

Two schools of Rajkot city were chosen for the above experiments. In Std.8 the number of boys as samples in experimental group and controlled group were 35 and 35 respectively whereas number of girls in both the groups were 34 and 35 respectively. In class-9 the number of boys as samples were

35 to 35 respectively whereas the number of girls where 35 and 35 respectively. In Class-10 the number of boys were 35 and 35 respectively and girls were 35 and 35 respectively.

To test the dependent variables involved in study with the help of teacher made test which covered the selected units of science, the measurement of science achievement was done. For the measurement of science confidence by making use of "I want to speak about mathematics" designed by Sejpal D. K., the researcher designed a science confidence measurement test and on the basis of that the science confidence was measured. For the measurement of science retention, the teacher made test was used. When the first test was taken the score obtained by that test were preserved. After one and half month the test was repeated and again the scores were recorded. The difference of the score was taken as retention.

5.3 ANALYSIS AND INTERPRETATION OF ACQUIRED INFORMATION THROUGH EXPERIMENT :

Two group experimental design corresponding to the objectives of the study were used and six experiments were made as shown above. In each experiment after care-treatment to computer aided teaching method on experimental group and lecture method on controlled group with the help of appropriate tools, the measurement of science achievement, science confidence and science retention was done.

To examine the effect of teaching method on science achievement, science confidence and science retention the analysis and interpretation of acquired information through each experiment has been shown in order.

Besides, the decision regarding acceptance and non-acceptance of related null-hypothesis and research hypothesis has also been presented.

5.3.1 The analysis and interpretation of acquired scores at the end of experimental-1.

To examine the affect of computer assisted teaching method on science achievement, science confidence and science retention the experiment was conducted on boys of std. 8. During the experiment two groups; experimental group and controlled group, which were formed accidentally, were subjected to teaching by lecture method and computer assisted learning method in sequence.

The scores obtained at the end of the experiments are shown in Table 5.1. The analysis of these scores suitable to the objectives of the study has been presented in Table 5.2.

In this table the analysis has been shown in three parts. The upper part contains the analysis of scores of science achievement, the middle contains the analysis of scores of confidence in science and the lower part contains analysis of scores of science retention. In each analysis the value for determining the significance of number of subjects in experimental and controlled group, average of scores of dependent variables, standard deviation and the difference between two averages has been shown.

Table - 5.1
Scores of experimental and controlled group obtained at the end of experimental-1
Std. : 8; Sex : Boys; Group : Experimental; Science achievement

Sequence of Subject (Students)	*Science achievement*	*Science confidence*	*Science achievement retest*	*Retention forgetting scores*
1	73	65	70	3
2	82	69	77	5
3	57	50	52	5
4	58	65	55	3
5	68	62	65	3
6	74	70	70	4
7	46	62	35	11
8	81	60	75	6
9	65	48	60	5
10	42	55	35	7
11	59	65	50	9
12	71	62	65	6
13	74	60	62	12
14	38	38	33	5
15	45	50	37	8
16	65	68	61	4
17	72	70	66	6
18	42	45	38	4
19	81	80	79	2
20	60	62	55	5
21	65	68	61	4
22	72	65	70	2
23	45	50	40	5
24	55	54	51	4
25	62	55	61	1
26	65	70	62	3
27	74	70	70	4
28	65	60	62	3
29	75	55	70	5
30	51	44	35	16
31	39	74	31	8
32	92	85	88	4
33	55	67	42	13
34	65	75	55	10
35	85	78	81	4
Total strength	2218	2176		199
Average	63.37	62.17		5.68
Standard deviation	13.92	10.70		3.34

Scores of experimental and controlled group at the end of experiment-1
Std. : 8; Sex : Boys; Group : Controlled; Science achievement

Sequence of Subject (Students)	*Science achievement*	*Science confidence*	*Science achievement retest*	*Retention forgetting scores*
1	49	47	43	6
2	62	61	57	5
3	55	54	47	8
4	58	65	51	7
5	64	62	58	6
6	48	45	41	7
7	58	59	53	5
8	78	80	71	7
9	71	74	62	9
10	64	61	57	7
11	54	54	49	5
12	52	51	47	5
13	59	49	56	3
14	74	72	66	8
15	48	45	41	7
16	36	39	27	9
17	48	51	37	11
18	74	71	65	9
19	48	51	42	6
20	46	51	38	8
21	38	40	32	6
22	39	45	31	8
23	69	65	58	11
24	47	44	37	10
25	68	66	58	10
26	47	44	42	5
27	59	51	52	7
28	85	82	77	8
29	78	72	71	7
30	65	61	52	13
31	58	55	52	6
32	64	61	58	6
33	35	35	32	3
34	55	58	51	4
35	47	45	41	6
Total strength	2000	1966		248
Average	57.14	56.17		7.09
Standard deviation	12.72	11.88		2.26

Table - 5.2

Analysis of the scores at the end of Experimental-1

(Std. 8; Sex - Boys)

Dependent Variable : Science Achievement

Group	Strength	Average	Standard deviation	t-value
Experimental	35	63.37	13.92	1.961*
Controlled	35	57.14	12.72	

Dependent Variable : Science Confidence

Group	Strength	Average	Standard deviation	t-value
Experimental	35	62.17	10.70	2.226*
Controlled	35	56.17	11.88	

Dependent Variable : Science Retention

Group	Strength	Average	Standard deviation	t-value
Experimental	35	5.68	3.34	2.055*
Controlled	35	7.08	2.26	

* Significant at 0.05 level

** Significant at 0.01 level

The table 5.2 indicates that the average of science achievement of experimental group was higher that of the controlled group, because t-value of significance of different of both the averages of both the subjects of both the group was 1.961 which was significant at 0.05 level. Thus the First Null

Hypothesis of the study was not accepted. As a result of this the First Research Hypothesis is accepted. That is, the computer assisted teaching method was more effective than lecture method in terms of computer assisted science achievement in context of science achievement of boys of Class 8.

The t-value for the significance of difference between averages of scores of science confidence of experimental and controlled group was 2.226, which is significant at 0.05 level. This suggests that there is a significant difference between the averages of two groups. So the Second Null Hypothesis is not being accepted. As a result, the Second Hypothesis is accepted. So it can be said that in comparison to lecture method the science confidence of the students taught by computer assisted teaching was higher. In short we can say that the computer assisted learning method was more effective than lecture method, in terms of science faith of boys of Class 8.

The t-value for the significance of difference between averages of scores of science retention in boys of experimental and controlled group was 2.055, which is significant at 0.05 level. This suggests that there is a significant difference between the averages of both the groups. So the Third Null Hypothesis is not accepted and as a result, the Third Research Hypothesis is accepted. The average of experimental group is lower than controlled group, so it can be said that in comparison to lecture method the science retention of the boys of science students taught by computer assisted teaching was better, that is, there forgetfulness was less. In short it can be said that the computer assisted learning method was more effective than lecture method in terms of science retention of boys of Class 8.

It can be concluded from the acquired results of experimental-1 that the science achievement of boys who received teaching through computer

assisted teaching was higher than the learning method. The confidence in science was more and science retention was also high.

5.3.2 The analysis and interpretation of acquired scores at the end of experimental-2.

To examine the effect of computer assisted teaching method on science achievement, science confidence and science retention, this experiment was conducted on girls of std.8. During this experiment, the teaching was done through lecture method and computer assisted teaching method on two accidentally formed groups; experimental group and controlled group.

The scores acquired at the end of the experiment are shown in Table 5.3. The analysis of scores corresponding to the objectives of study are presented in Table 5.4

In the table, the analysis is shown in three parts. In the upper part the analysis of scores of science achievement, in middle part the scores of analysis of science confidence and in the lower part analysis of scores of science retention has been shown. In each analysis, the values for determining the strength of subjects, averages of scores of dependent variables, standard deviation and the significance of difference between two averages are shown.

Table - 5.3
Scores of experimental and controlled group obtained at the end of experimental-2
Std. : 8; Sex : Girls; Group : Experimental; Science Confidence

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	49	42	46	3
2	55	52	53	2
3	50	54	44	6
4	57	55	53	4
5	88	85	84	4
6	65	65	61	4
7	75	62	72	3
8	86	71	82	4
9	49	49	46	3
10	66	61	63	3
11	86	74	83	3
12	75	69	72	3
13	45	52	41	4
14	59	57	54	5
15	95	82	90	5
16	75	74	73	2
17	53	55	49	4
18	51	44	49	2
19	65	65	62	3
20	59	59	56	3
21	56	61	51	5
22	60	60	58	2
23	45	40	43	2
24	69	72	66	3
25	75	70	74	1
26	79	71	75	4
27	59	61	57	2
28	69	62	65	4
29	72	64	69	3
30	59	59	56	3
31	67	67	65	2
32	61	62	59	2
33	54	57	50	4
34	55	58	50	5
35	62	61	55	7
Total strength	2245	2152		119
Average	64.14	61.49		3.40
Standard deviation	12.72	10.09		1.29

Scores of experimental and controlled group at the end of experiment-2
Std. : 8; Sex : Girls; Group : Controlled; Science Confidence

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	45	48	40	5
2	44	42	40	4
3	53	51	45	8
4	49	47	45	4
5	61	65	55	6
6	40	52	35	5
7	54	53	50	4
8	81	74	75	6
9	61	60	54	7
10	71	58	65	6
11	74	61	68	6
12	59	59	57	2
13	61	49	58	3
14	68	65	65	3
15	40	39	38	2
16	45	40	41	4
17	81	71	75	6
18	71	68	65	6
19	48	47	44	4
20	51	44	45	6
21	54	51	52	2
22	61	59	58	3
23	49	51	47	2
24	51	53	49	2
25	55	51	50	5
26	56	45	51	5
27	61	65	58	3
28	71	62	66	5
29	73	64	72	1
30	49	58	44	5
31	61	57	60	1
32	62	55	59	3
33	59	53	54	5
34	54	57	48	6
35	49	51	41	8
Total strength	2022	1925		153
Average	57.77	55.00		4.37
Standard deviation	10.85	8.60		1.86

Table - 5.4

Analysis of the acquired scores at the end of Experimental-2

(Std. 8; Sex - Girls)

Dependent Variable : Science Achievement

Group	Strength	Average	Standard deviation	t-value
Experimental	35	64.14	12.72	2.254*
Controlled	35	57.77	10.85	

Dependent Variable : Science Confidence

Group	Strength	Average	Standard deviation	t-value
Experimental	35	61.49	10.09	2.893**
Controlled	35	55.00	8.60	

Dependent Variable : Science Retention

Group	Strength	Average	Standard deviation	t-value
Experimental	35	3.40	1.29	2.536*
Controlled	35	4.37	1.86	

* Significant at 0.05 level

** Significant at 0.01 level

The table 5.4 suggests that the average of science achievement of subjects of experimental group was significantly higher than that of the controlled group, because the t-value for significance of difference between averages of the subjects of two group was 2.254 which was significant at 0.05 level. Thus the Fourth Null Hypothesis is not being accepted. As a result of

this the Fourth Research Hypothesis is accepted. That is, the computer assisted teaching method was more effective than lecture method in terms of computer assisted science achievement in context of science achievement of girls of Class 8.

The t-value for the significance of difference between averages of scores of science confidence of experimental and controlled group was 2.893, which is significant at 0.01 level. This suggests that there is a significant difference between the averages of two groups. So the Fifth Null Hypothesis is not accepted. As a result, the Fifth Research Hypothesis is accepted. So it can be said that the science confidence of the students taught by computer assisted teaching method was more effective than lecture method in terms of science confidence of girls of Class-8.

The t-value for the significance of difference between averages of science retention in girls of experimental and controlled group was 2.536, which is significant at 0.05 level. This suggests that there is a significance difference between two averages. So the Sixth Null Hypothesis is not being accepted. As a result, the Sixth Research Hypothesis is accepted. The average of experimental group is lower than controlled group. So it can be said that in comparison to lecture method, the science retention of the girls taught by computer assisted teaching method was better, that is, there is forgetfulness was low. In short, the computer assisted learning method was more effective than lecture method in terms of science retention of girls of Class 8.

It can be concluded from the results obtained from the experimental-2 that the science achievement of girls taught by computer assisted teaching method was higher than the lecture method. The confidence in science was high and the retention was also high.

5.3.3 The analysis and interpretation of scores acquired at the end of experimental-3.

This experiment was conducted on the boys of Std. 9 to examine the effect of computer assisted teaching method on science achievement, science confidence and science retention. During the experiment, the teaching was done by lecture method and computer assisted teaching method on accidentally formed two groups; experimental and controlled groups.

The scores acquired at the end of the experiment are shown in Table 5.5. The analysis of scores corresponding to the objectives of study are presented in Table 5.6

In this table, the analysis has been in three parts. In the upper part has the analysis of scores of science achievement; in middle part the scores of analysis of science confidence and in the lower part analysis of scores of science retention. In each analysis, the values for determining the strength of subjects of both the groups, averages of scores of dependent variables, standard deviation and the significance of difference between two averages has been shown.

Table - 5.5
Scores of experimental and controlled group obtained at the end of experimental-3
Std. : 9; Sex : Boys; Group : Experimental; Science Retention

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	51	52	48	3
2	48	42	45	3
3	58	52	52	6
4	56	50	50	6
5	69	71	65	4
6	49	54	43	6
7	56	55	52	4
8	87	85	83	4
9	64	65	60	4
10	65	61	62	3
11	85	74	82	3
12	74	69	71	3
13	63	60	60	3
14	85	89	83	2
15	44	52	40	4
16	58	57	53	5
17	94	82	89	5
18	74	74	72	2
19	52	55	48	4
20	60	61	55	5
21	59	62	53	6
22	70	65	64	6
23	58	59	55	3
24	55	61	50	5
25	59	60	57	2
26	44	40	42	2
27	68	72	65	3
28	74	70	73	1
29	78	71	74	4
30	58	61	56	2
31	68	62	64	4
32	71	64	68	3
33	66	67	64	2
34	60	62	58	2
35	53	57	49	4
Total strength	2233	2193		128
Average	63.8	62.65		3.66
Standard deviation	12.25	10.72		1.39

Scores of experimental and controlled group at the end of experiment-3
Std. : 9; Sex : Boys; Group : Controlled; Science achievement

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	48	50	41	7
2	39	41	34	5
3	52	53	47	5
4	49	47	44	5
5	61	65	54	7
6	40	52	34	6
7	54	53	49	5
8	81	74	74	7
9	61	60	53	8
10	51	52	44	7
11	81	63	77	4
12	59	59	56	3
13	61	49	57	4
14	68	65	64	4
15	40	39	37	3
16	45	40	40	5
17	51	44	44	7
18	54	51	51	3
19	49	43	44	5
20	51	49	44	7
21	52	51	44	8
22	61	59	57	4
23	49	51	46	3
24	51	53	48	3
25	55	51	49	6
26	56	45	50	6
27	49	58	43	6
28	61	57	59	2
29	62	55	58	4
30	52	51	49	3
31	47	49	39	8
32	62	66	56	6
33	59	53	53	6
34	54	57	47	7
35	49	51	40	9
Total strength	1914	1856		188
Average	54.69	53.03		5.37
Standard deviation	9.49	7.86		1.80

Table - 5.6

Analysis of the scores at the end of Experimental-3

(Std. 9; Sex - Boys)

Dependent Variable : Science Achievement

Group	Strength	Average	Standard deviation	t-value
Experimental	35	63.80	12.25	3.488**
Controlled	35	54.68	9.49	

Dependent Variable : Science Confidence

Group	Strength	Average	Standard deviation	t-value
Experimental	35	62.65	10.72	4.300**
Controlled	35	53.02	07.86	

Dependent Variable : Science Retention

Group	Strength	Average	Standard deviation	t-value
Experimental	35	3.65	1.39	4.457**
Controlled	35	5.37	1.80	

* Significant at 0.05 level

** Significant at 0.01 level

The table 5.5 suggests that the analysis of science achievement of subject of experimental group was significantly higher than that of the controlled group because the t-value for significance of different between averages of subjects of both the group was 3.488 which was significant at

0.01 level. So the Seventh Null Hypothesis is not accepted. As a result of this the Seventh Research Hypothesis is being accepted. That is, the computer assisted teaching method was more effective than lecture method in terms of computer assisted science achievement in context of science achievement of boys of Std. 9.

The t-value for the significance of difference between averages of scores of science confidence of the subject of both the group was 4.300, which is significant at 0.01 level. This suggests that there is a significant difference between the averages of two groups. So the Eighth Null Hypothesis is not being accepted. As a result, the Eighth Research Hypothesis is accepted. So it can be said that in comparison to lecture method, the science confidence of boys taught through computer assisted teaching method was higher. In short, the computer assisted teaching method was more effective than lecture method, in terms of science confidence of boys of Std. 9.

The t-value for the significance of difference between averages of scores of science retention in boys of experimental and controlled group was -4.457, which is significant at 0.01 level. This suggests that there is a significant difference between the averages of both the groups. So the Ninth Null Hypothesis is not accepted and as a result, the Ninth Research Hypothesis is accepted. The average of experimental group is lower than controlled group, so it can be said that in comparison to lecture method the science retention of the boys taught through computer assisted teaching method was better, that is, there forgetfulness was less. In short, the computer assisted lecture method was more effective than the lecture method in terms of science retention of boys of Std. 9.

It can be concluded from the acquired results of experimental-3 that the science achievement of boys who received teaching through computer assisted teaching was higher than the lecture method. Science confidence was more and science retention was also high.

5.3.4 The analysis and interpretation of scores obtained at the end of experimental-4.

This experiment was conducted on the girls of Std. 9 to examine the effect of computer assisted teaching method on science achievement, science confidence and science retention. During the experiment the teaching was done through lecture method and computer assisted teaching method on accidentally formed two groups; experimental group and controlled group

The scores obtained at the end of the experiment are shown in Table 5.7. The analysis of scores corresponding to the objectives of study are presented in Table 5.8

In this table, the analysis has been shown in three parts. The upper part has the analysis of scores of science achievement, the middle part has analysis of scores of science confidence and the lower part has the analysis of scores of science retention. In each analysis, the values for determining the strength of subjects of both the methods, averages of scores of dependent variables, standard deviation and the significance of difference between two averages has been shown.

Table 5.7
Scores of experimental and controlled group obtained at the end of experimental-4
Std. : 9; Sex : Girls; Group : Experimental; Science achievement

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	65	61	62	3
2	51	52	48	3
3	48	42	45	3
4	58	52	52	6
5	56	50	50	6
6	56	55	52	4
7	87	85	83	4
8	64	65	60	4
9	74	62	71	3
10	65	61	62	3
11	85	74	82	3
12	74	69	71	3
13	63	60	60	3
14	85	89	83	2
15	44	52	40	4
16	74	74	72	2
17	52	55	48	4
18	50	44	48	2
19	64	65	61	3
20	54	50	50	4
21	55	61	50	5
22	59	60	57	2
23	44	40	42	2
24	68	72	65	3
25	74	70	73	1
26	78	71	74	4
27	58	61	56	2
28	68	62	64	4
29	71	64	68	3
30	58	59	55	3
31	54	57	53	1
32	53	57	49	4
33	54	58	49	5
34	61	61	54	7
35	54	54	48	6
Total strength	2178	2124		121
Average	62.22	60.68		3.45
Standard deviation	11.39	10.63		1.40

Scores of experimental and controlled group at the end of experiment-4
Std. : 9; Sex : Girls; Group : Controlled; Science achievement

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	39	41	35	4
2	52	53	48	4
3	45	48	40	5
4	61	65	55	6
5	40	52	35	5
6	54	53	50	4
7	81	74	75	6
8	61	60	54	7
9	71	58	65	6
10	81	63	78	3
11	59	59	57	2
12	61	49	58	3
13	40	39	38	2
14	45	40	41	4
15	81	71	75	6
16	48	47	44	4
17	51	44	45	6
18	54	51	52	2
19	49	43	45	4
20	51	49	45	6
21	52	51	45	7
22	49	51	47	2
23	51	53	49	2
24	55	51	50	5
25	61	65	58	3
26	71	62	66	5
27	73	64	72	1
28	49	58	44	5
29	61	57	60	1
30	47	49	40	7
31	62	66	57	5
32	59	53	54	5
33	54	57	48	6
34	49	51	41	8
35	48	52	39	9
Total strength	1965	1899		160
Average	56.14	54.25		4.57
Standard deviation	11.32	8.50		1.97

Table - 5.8

Analysis of the scores at the end of Experimental-4

(Std. 9; Sex - Girls)

Dependent Variable : Science Achievement

Group	Strength	Average	Standard deviation	t-value
Experimental	35	62.22	11.39	2.241*
Controlled	35	56.14	11.32	

Dependent Variable : Science Confidence

Group	Strength	Average	Standard deviation	t-value
Experimental	35	60.68	10.63	2.793**
Controlled	35	54.25	8.50	

Dependent Variable : Science Retention

Group	Strength	Average	Standard deviation	t-value
Experimental	35	3.45	1.40	2.723**
Controlled	35	4.57	1.97	

* Significant at 0.05 level

** Significant at 0.01 level

The table 5.8 suggests that the average of science achievement of subjects of experimental group was higher that of the controlled group because the t-value for the significance of difference between averages of subjects of both the groups was 2.241 which is significant at 0.05 level. So,

the Tenth Null Hypothesis of the study was not accepted. As a result of this the Tenth Research Hypothesis is accepted. That is, the computer assisted teaching method was more effective than lecture method in terms of computer assisted science achievement in context of science achievement of girls of Class 9.

The t-value for the significance of difference between averages of scores of science confidence of experimental and controlled group was 2.793, which is significant at 0.01 level. This suggests that there is a significant difference between the averages of two groups. So the Eleventh Null Hypothesis of the study is not accepted. As a result, the Eleventh Research Hypothesis is accepted. So it can be said that in comparison to lecture method, the science confidence of the students taught by computer assisted teaching method was high. In short we can say that the computer assisted teaching method was more effective than lecture method, in terms of science faith of girls of Std. 9.

The t-value for the significance of difference between averages of scores of science retention in girls of experimental and controlled group was 2.723, which is significant at 0.01 level. This suggests that there is a significant difference between the averages of both the groups. So the Twelfth Null Hypothesis of the study is not accepted. As a result the Twelfth Research Hypothesis is accepted. The average of experimental group is lower than controlled group, so it can be said that in comparison to lecture method the science retention of the girls of science students taught by computer assisted teaching method was better, that is, there forgetfulness was less. In short it can be said that the computer assisted learning method was more effective than lecture method in terms of science retention of girls of Std. 9.

It can be concluded from the acquired results of experimental-4 that the science achievement of girls taught by computer assisted teaching method was higher than the lecture method. Science confidence was high and science retention was also high.

5.3.5 The analysis and interpretation of acquired scores at the end of experimental-5.

This experiment was conducted on boys of Std. 10 to examine the effect of computer assisted teaching method on science achievement, science confidence and science retention. During this experiment, lecture method and computer assisted teaching method on accidentally formed two groups; experimental group and controlled group did the teaching.

The scores obtained at the end of the experiment are shown in Table 5.9. The analysis of these scores corresponding to the objectives of the study is presented in Table 5.10 in which the analysis was shown in three parts.

In the upper part the analysis of scores of science achievement, in middle part the scores of analysis of science confidence and in the lower part analysis of scores of science retention has been shown. In each analysis, the values for determining the strength of subjects of both the groups, averages of scores of dependent variables, standard deviation and the significance of difference between two averages have been shown.

Table - 5.9
Scores of experimental and controlled group obtained at the end of experimental-5
Std. : 10; Sex : Boys; Group : Experimental; Science retention

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	57	55	54	3
2	45	45	43	2
3	65	61	62	3
4	56	50	50	6
5	69	71	65	4
6	49	54	43	6
7	56	55	52	4
8	87	85	83	4
9	64	65	60	4
10	74	62	71	3
11	85	71	81	4
12	74	69	71	3
13	63	60	60	3
14	85	89	83	2
15	44	52	40	4
16	58	57	53	5
17	74	74	72	2
18	52	55	48	4
19	60	61	55	5
20	59	62	53	6
21	70	65	64	6
22	58	59	55	3
23	55	61	50	5
24	59	60	57	2
25	44	40	42	2
26	68	72	65	3
27	74	70	73	1
28	78	71	74	4
29	58	61	56	2
30	71	64	68	3
31	58	59	55	3
32	54	57	53	1
33	53	57	49	4
34	54	58	49	5
35	61	61	54	7
Total strength	2191	2168		128
Average	62.60	61.94		3.65
Standard deviation	11.36	9.74		1.49

Scores of experimental and controlled group at the end of experiment-5
Std. : 10; Sex : Boys; Group : Controlled; Science achievement

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	48	50	42	6
2	39	41	35	4
3	52	53	48	4
4	45	48	40	5
5	44	42	40	4
6	40	52	35	5
7	54	53	50	4
8	81	74	75	6
9	61	60	54	7
10	71	58	65	6
11	74	61	68	6
12	40	44	38	2
13	61	49	58	3
14	68	65	65	3
15	40	39	38	2
16	45	40	41	4
17	81	71	75	6
18	71	68	65	6
19	48	47	44	4
20	51	44	45	6
21	52	51	45	7
22	61	59	58	3
23	49	51	47	2
24	51	53	49	2
25	55	51	50	5
26	56	45	51	5
27	61	65	58	3
28	71	62	66	5
29	73	64	72	1
30	52	51	50	2
31	47	49	40	7
32	62	66	57	5
33	59	53	54	5
34	54	57	48	6
35	49	51	41	8
Total strength	1966	1887		159
Average	56.17	53.91		4.54
Standard deviation	11.82	9.16		1.76

Table - 5.10

Analysis of the scores at the end of Experimental-5

(Std. 10; Sex - Boys)

Dependent Variable : Science Achievement

Group	Strength	Average	Standard deviation	t-value
Experimental	35	62.60	11.36	2.328*
Controlled	35	56.17	11.73	

Dependent Variable : Science Confidence

Group	Strength	Average	Standard deviation	t-value
Experimental	35	61.94	9.74	3.570**
Controlled	35	53.91	9.05	

Dependent Variable : Science Retention

Group	Strength	Average	Standard deviation	t-value
Experimental	35	3.65	1.49	2.274*
Controlled	35	4.54	1.75	

* Significant at 0.05 level

** Significant at 0.01 level

The table 5.10 suggests that the average of science achievement of subject of experimental group was higher than that of the controlled group, because t-value for the significance of difference between averages of subjects of both the group was 2.328 which is significant at 0.05 level. Thus

the Thirteenth Null Hypothesis of the study is not accepted. As a result of this the Thirteenth Research Hypothesis is accepted. That is, the computer assisted teaching method was more effective than lecture method in terms of computer assisted science achievement in context of science achievement of boys of Class 10.

The t-value for the significance of difference between averages of scores of science confidence of subjects of both the groups was 3.570, which is significant at 0.01 level. This suggests that there is a significant difference between the averages of two groups. So the Fourteenth Null Hypothesis of the study is not being accepted. As a result, the Fourteenth Hypothesis is accepted. So it can be said that in comparison to lecture method the science confidence of the boys taught by computer assisted teaching was high. In short, the computer assisted teaching method was more effective than lecture method, in terms of science confidence of boys of Std. 10.

The t-value for the significance of difference between averages of scores of science retention in boys of experimental and controlled group was 2.274, which is significant at 0.05 level. This suggests that there is a significant difference between the averages of both the groups. So the Fifteenth Null Hypothesis of the study is not accepted. As a result, the Fifteenth Research Hypothesis is accepted. The average of experimental group is lower than controlled group, so it can be said that in comparison to lecture method the science retention of the boys of science students taught by computer assisted teaching method was better, that is, there forgetfulness was less. In short, the computer assisted teaching method was more effective than lecture method in terms of science retention of boys of Std. 10.

It can be concluded from the acquired results of experimental-5 that the science achievement of boys who received teaching through computer assisted teaching was higher than the lecture method. Science confidence was high and science retention was also high.

5.3.6 The analysis and interpretation of scores obtained at the end of experimental-6.

This experiment was conducted on girls of Std.10 to examine the effect of computer assisted teaching method on science achievement, science confidence and science retention. During this experiment, the teaching was done through lecture method and computer assisted teaching method on accidentally formed two groups; experimental group and controlled group.

The scores acquired at the end of the experiment are shown in Table 5.11. The analysis of scores corresponding to the objectives of study are presented in Table 5.12

In the table, the analysis is shown in three parts. In the upper part the analysis of scores of science achievement, in middle part the scores of analysis of science confidence and in the lower part analysis of scores of science retention has been shown. In each analysis, the values for determining the strength of subjects of both the groups, averages of scores of dependent variables, standard deviation and the significance of difference between two averages have been shown.

Table 5.11
Scores of experimental and controlled group obtained at the end of experimental-6
Std. : 10; Sex : Girls; Group : Experimental; Science retention

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	66	61	63	3
2	52	52	49	3
3	49	42	46	3
4	59	52	53	6
5	70	71	66	4
6	50	54	44	6
7	57	55	53	4
8	65	65	61	4
9	75	62	72	3
10	86	71	82	4
11	49	49	46	3
12	86	74	83	3
13	75	69	72	3
14	45	52	41	4
15	59	57	54	5
16	95	82	90	5
17	75	74	73	2
18	51	44	49	2
19	65	65	62	3
20	55	50	51	4
21	60	62	54	6
22	71	65	65	6
23	59	59	56	3
24	56	61	51	5
25	60	60	58	2
26	69	72	66	3
27	79	71	75	4
28	59	61	57	2
29	59	59	56	3
30	55	57	54	1
31	72	71	69	3
32	61	62	59	2
33	54	57	50	4
34	55	58	50	5
35	62	61	55	7
Total strength	2215	2137		130
Average	63.29	61.06		3.71
Standard deviation	11.66	8.95		1.40

Scores of experimental and controlled group at the end of experiment-6
Std. : 10; Sex : Girls; Group : Controlled; Science achievement

Sequence of Subject (Students)	Science achievement	Science confidence	Science achievement retest	Retention forgetting scores
1	45	48	40	5
2	44	42	40	4
3	53	51	45	8
4	49	47	45	4
5	61	65	55	6
6	40	52	35	5
7	54	53	50	4
8	81	74	75	6
9	61	60	54	7
10	71	58	65	6
11	74	61	68	6
12	59	59	57	2
13	61	49	58	3
14	68	65	65	3
15	40	39	38	2
16	45	40	41	4
17	81	71	75	6
18	71	68	65	6
19	49	43	45	4
20	51	49	45	6
21	52	51	45	7
22	61	59	58	3
23	49	51	47	2
24	51	53	49	2
25	55	51	50	5
26	56	45	51	5
27	61	65	58	3
28	71	62	66	5
29	73	64	72	1
30	49	58	44	5
31	61	57	60	1
32	62	66	57	5
33	59	53	54	5
34	54	57	48	6
35	52	53	45	7
Total strength	2024	1939		159
Average	57.82	55.4		4.54
Standard deviation	10.79	8.77		1.80

Table - 5.12

Analysis of the scores at the end of Experimental-6

(Std. 10; Sex - Girls)

Dependent Variable : Science Achievement

Group	Strength	Average	Standard deviation	t-value
Experimental	35	63.29	11.66	2.031*
Controlled	35	57.82	10.79	

Dependent Variable : Science Confidence

Group	Strength	Average	Standard deviation	t-value
Experimental	35	61.05	8.95	2.670**
Controlled	35	55.40	8.77	

Dependent Variable : Science Retention

Group	Strength	Average	Standard deviation	t-value
Experimental	35	3.71	1.40	2.143*
Controlled	35	4.54	1.80	

*0.05 level significant

**0.01 level significant

The table 5.12 suggests that the average of science achievement of subjects of experimental group was significantly higher than that of the controlled group, because the t-value for significance of difference between averages of the subjects of two groups was 2.031, which is significant at 0.05

level. Thus the Sixteenth Null Hypothesis of the study is not being accepted. As a result of this the Sixteenth Research Hypothesis is accepted. That is, the computer assisted teaching method was more effective than lecture method in terms of computer assisted science achievement girls of Class 10.

The t-value for the significance of difference between averages of scores of science confidence of experimental and controlled group was 2.670, which is significant at 0.01 levels. This suggests that there is a significant difference between the averages of two groups. So the Seventeenth Null Hypothesis is not accepted. As a result, the Seventeenth Research Hypothesis is accepted. So it can be said that in comparison to lecture method the science confidence of the girls taught by computer assisted teaching method was high. In short, the computer assisted teaching method was more effective than lecture method in terms of science confidence of girls of Class-10.

The t-value for the significance of difference between averages of science retention in girls of experimental and controlled group was 2.143, which is significant at 0.05 levels. This suggests that there is a significance difference between averages of both the groups. So the Eighteenth Null Hypothesis is not being accepted. As a result, the Eighteenth Research Hypothesis is accepted. The average of experimental group is lower than controlled group. So it can be said that in comparison to lecture method, the science retention of the girls taught by computer assisted teaching method was better, that is, there is forgetfulness was less. In short, the computer assisted learning method was more effective than lecture method in terms of science retention of girls of Class 10.

It can be concluded from the results obtained from the experimental-6 that the science achievement of girls taught by computer assisted teaching method was higher than the lecture method. Science confidence was high and science retention was also high.

5.4 DISCUSSION ON THE RESULTS OBTAINED IN TERMS OF EFFECTIVENESS OF COMPUTER ASSISTED TEACHING METHOD ON ACHIEVEMENT OF SCIENCE:

Considering the standards and sex of the subjects six experiments were conducted in this research, their results are being presented here. From this discussion whether the computer assisted teaching method, in comparison to lecture method is effective or not can be examined in terms of science achievement. After co-ordinating the acquired results of experiment in terms of science achievement it has been presented in Table No. 13

Table - 5.13

Results obtained in terms of science achievement

Experiment No.	Standard	Sex of learner	Result of Experiment
1	8	Boys	In comparison to lecture method, the boys of Std.8 acquired high science achievement through computer assisted teaching method. So computer assisted teaching method was more effective.
2	8	Girls	In comparison to lecture method, the girls of Std. 8 acquired high science achievement through computer assisted teaching method. So computer assisted teaching method was more effective.
3	9	Boys	In comparison to lecture method, the boys of Std. 9 acquired high science achievement through computer assisted teaching method. So computer assisted teaching method was more effective.
4	9	Girls	In comparison to lecture method, the girls of Std. 9 acquired high science achievement through computer assisted teaching method. So computer assisted teaching method was more effective.
5	10	Boys	In comparison to lecture method, the boys of Std. 10 acquired high science achievement through computer assisted teaching method. So computer assisted teaching method was more effective.
6	10	Girls	In comparison to lecture method, the girls of Std. 10 acquired high science achievement through computer assisted teaching method. So computer assisted teaching method was more effective.

The result presented in Table No. 13 indicate that the comparison to lecture method if computer assisted teaching method is used on Std. 8, 9, 10 at secondary level on boys or girls as subjects of experiments the science achievement has shown significant increase, that is, if it is examined in terms of science achievement, the computer assisted teaching method was more effective as compared to the lecture method.

Thus the teaching method influences the science achievement. This influence was equal on standards and sex, i.e. there was no effect of standard (variable) or sex (variable) on the relationship between teaching method (independent variable) and science achievement (dependent variable).

5.5 DISCUSSION ON RESULTS OBTAINED IN TERMS OF EFFECTIVENESS OF COMPUTER ASSISTED TEACHING METHOD ON SCIENCE CONFIDENCE :

Experiments were conducted to examine the effect of computer assisted teaching method on science confidence. The discussion of the result is presented here. The co-ordination of acquired results of six experiments in terms of science confidence has been presented in Table 5.14 as under.

Table - 5.14

Results obtained in terms of science confidence

Experiment No.	Standard	Sex of learner	Result of Experiment
1	8	Boys	In comparison to lecture method, the science confidence of boys of Std.8 taught through computer assisted teaching method was higher. So computer assisted teaching method was more effective.
2	8	Girls	In comparison to lecture method, the science confidence of girls of Std. 8 taught through computer assisted teaching method was higher. So computer assisted teaching method was more effective.
3	9	Boys	In comparison to lecture method, the science confidence of boys of Std. 9 taught through computer assisted teaching method was higher. So computer assisted teaching method was more effective.
4	9	Girls	In comparison to lecture method, the science confidence of girls of Std. 9 taught through computer assisted teaching method was higher. So computer assisted teaching method was more effective.
5	10	Boys	In comparison to lecture method, the science confidence of boys of Std. 10 taught through computer assisted teaching method was higher. So computer assisted teaching method was more effective.
6	10	Girls	In comparison to lecture method, the science confidence of girls of Std. 10 taught through computer assisted teaching method was higher. So computer assisted teaching method was more effective.

The conclusion of six experiments shown in Table 5.14 can be presented as under:

The results of experiments on Std. 8, 9, 10 show that the computer assisted teaching method is more effective than the lecture method. The results in terms of teaching method in science confidence suggest that the effect was same for Std. 8, 9 and 10. From this it can be said that there is no effect of standard in between teaching method and science confidence.

Both the results of boys and girls of Std. 8, 9, 10 show that computer assisted teaching method was more effective than lecture method. This result also suggests that the effect of sex on the relationship between teaching method and science confident is not found. From the results of six experiments to examine the effect of teaching method on science confidence it can be said that the computer assisted teaching method is more effective than lecture method.

5.6 DISCUSSION ON RESULTS OBTAINED IN TERMS OF EFFECTIVENESS OF COMPUTER ASSISTED TEACHING METHOD ON SCIENCE RETENTION.

Considering the standard and sex of the students of experiment, the discussion from the results of six experiments in this research is presented here. In terms of science retention and in comparison to lecture method whether the computer assisted teaching method is effective or not that can be examined from the discussion.

The co-ordination of acquired results of six experiments conducted in terms of science retention is presented in Table 5.15.

Table - 5.15

Results obtained in terms of science confidence

Experiment No.	Standard	Sex of learner	Result of Experiment
1	8	Boys	In comparison to lecture method, the science retention of boys of Std. 8 taught through computer assisted teaching method was higher. So computer assisted teaching method is more effective.
2	8	Girls	In comparison to lecture method, the science retention of girls of Std. 8 taught through computer assisted teaching method was higher. So computer assisted teaching method is more effective.
3	9	Boys	In comparison to lecture method, the science retention of boys of Std. 9 taught through computer assisted teaching method was higher. So computer assisted teaching method is more effective.
4	9	Girls	In comparison to lecture method, the science retention of girls of Std. 9 taught through computer assisted teaching method was higher. So computer assisted teaching method is more effective.
5	10	Boys	In comparison to lecture method, the science retention of boys of Std. 108 taught through computer assisted teaching method was higher. So computer assisted teaching method is more effective.
6	10	Girls	In comparison to lecture method, the science retention of girls of Std. 10 taught through computer assisted teaching method was higher. So computer assisted teaching method is more effective.

The conclusion of six experiments shown in Table 5.15 can be presented as under:

The results of experiments on Std. 8, 9, 10 shows that the computer assisted teaching method is more effective than lecture method. The results in terms of effectiveness of teaching method on science retention suggest that the effect was equal for Std. 8, 9, 10. From this it can be said that there is no effect of standard between teaching method and science retention.

Both the results on boys or girls of Std. 8, 9, 10 shows that the computer assisted teaching method was more effective than the lecture method. These results suggest there is no effect of sex on the relationship between teaching method and science retention.

Thus, the results on teaching method and science retention show that there is no effect of standard and sex on teaching method and science retention.

From the results obtained at the end of six experiments to examine the effect of teaching method on science retention it can be said that computer assisted teaching method is more effective than lecture method.

CHAPTER - 6
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

CHAPTER - 6
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTORY :

The researcher has made an attempt to justify the chapter by giving necessary details of the summary of the study, tests on null hypothesis, conclusions of the study, implications and future studies for the purpose of recommendations.

Some problems which are related to the study and which can be selected for future studies are also referred at the end of the study.

6.2 SUMMARY OF THE RESULTS :

Keeping in mind the goal of examining whether the computer assisted teaching method is more effective than lecture method or not, in terms of dependent variable like science achievement, science confidence and science retention, this study was conducted. The experimental research method of two groups was used to test the teaching method as an independent variable. Necessary programmes for selected units of Std. 8, 9, 10 in terms of both the treatments viz. treatment of computer assisted teaching method on experimental group and treatment of lecture method on controlled group were prepared.

To clarify the application of results, six experiments were conducted, keeping in mind the variables like standard and sex.

The achievement tests were designed for Std. 8, 9, 10 for the measurement of dependent variable science achievement. For science confidence, an inventory designed by Sejpal D. K. for Science confidence based on "I may say about mathematics" was designed where as for science retention the science achievement test was used again for second time.

The decision regarding acceptance and non-acceptance of each hypothesis and it test suitably designed for the objectives of study has been presented in sequence as under :

➪ **FIRST NULL HYPOTHESIS :**

In context of the science of Std. 8, there may not be significant difference between the averages of scores of science achievement of boys taught through computer assisted teaching method and lecture method.

T-tests were used as statistical technique. The acquired t-value was 1.961 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result, the related first hypothesis was accepted, due to which it can be said that there was a significant difference between the science achievements of subjects of both the groups involved in the experiment.

➪ **SECOND NULL HYPOTHESIS :**

There may not be significant difference between the averages of the scores of science confidence of the boys who were taught by computer assisted teaching method and the lecture method in context of science subject of Class 8.

T-tests was used as the statistical technique. The acquired t-value was 2.226 which was significant at 0.05 level. So this null hypothesis was not

accepted. As a result, the related second hypothesis was accepted, due to which it can be said that there was a significant difference between the science confidence of subjects of both the groups involved in the experiment.

➪ **THIRD NULL HYPOTHESIS :**

In the context of the science of Std. 8, there may not be significant difference between the averages of scores of science retention of boys who were taught by computer assisted teaching method and lecture method.

T-tests were used as statistical technique. The acquired t-value was 2.055 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result of this, the related third hypothesis was accepted, due to which it can be said that there was a significant difference between the science context of the subjects of both the groups involved in the experiment.

➪ **FOURTH NULL HYPOTHESIS :**

In context of the science of Std. 8, there may not be significant difference between the averages of scores of science achievement of girls who were taught by computer assisted teaching method and lecture method.

T-tests were used as statistical technique. The acquired t-value was 2.254 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result, the related fourth hypothesis was accepted, due to which it can be said that there was a significant difference between the science achievements of subjects of both the groups involved in the experiment.

➪ **FIFTH NULL HYPOTHESIS :**

In context of the science of Std. 8, there may not be significant difference between the averages of scores of science confidence of girls who were taught by computer assisted teaching method and lecture method.

T-tests were used as statistical technique. The acquired t-value was 2.893 which was significant at 0.01 level. So this null hypothesis was not accepted. As a result of this, the related fifth hypothesis was accepted, due to which it can be said that there was a significant difference between the science confidence of the subjects of both the groups involved in the experiment.

➪ **SIXTH NULL HYPOTHESIS :**

In context of the science of Std. 8, there may not be significant difference between the averages of scores of science retention of girls who were taught by computer assisted teaching method and lecture method.

T-tests were used as statistical technique. The acquired t-value was 2.536 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result, the related sixth hypothesis was accepted, due to which it can be said that there was a significant difference between the retention of science context of subjects of both the groups involved in the experiment.

➪ **SEVENTH NULL HYPOTHESIS :**

In context of the science of Std. 9, there may not be a significant difference between the averages of scores of science achievement of boys who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 3.488 which was significant at 0.01 level. So this null hypothesis was not

accepted. As a result of this, the related seventh hypothesis was accepted, due to which it can be said that there was a significant difference between the science achievement of subjects of both the groups involved in the experiment.

➪ **EIGHTH NULL HYPOTHESIS :**

In context of the science of Std. 9, there may not be a significant difference between the averages of scores of science confidence of boys who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 4.300 which was significant at 0.01 level. So this null hypothesis was not accepted. As a result of this, the related eighth hypothesis was accepted, due to which it can be said that there was a significant difference between the science confidence of subjects of both the groups involved in the experiment.

➪ **NINTH NULL HYPOTHESIS :**

In context of the science of Std. 9, there may not be a significant difference between the averages of scores of retention of science context of boys who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 4.457 which was significant at 0.01 level. So this null hypothesis was not accepted. As a result of this, the related ninth hypothesis was accepted, due to which it can be said that there was a significant difference between the retention of science context of subjects of both the groups involved in the experiment.

➪ **TENTH NULL HYPOTHESIS :**

In context of the science of Std. 9, there may not be a significant difference between the averages of scores of science achievement of girls who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 2.241 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result of this, the related tenth hypothesis was accepted, due to which it can be said that there was a significant difference between the science achievement of subjects of both the groups involved in the experiment.

➪ **ELEVENTH NULL HYPOTHESIS :**

In context of the science of Std. 9, there may not be a significant difference between the averages of scores of science confidence of girls who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 2.793 which was significant at 0.01 level. So this null hypothesis was not accepted. As a result of this, the related eleventh hypothesis was accepted, due to which it can be said that there was a significant difference between the science confidence of subjects of both the groups involved in the experiment.

➪ **TWELFTH NULL HYPOTHESIS :**

In context of the science of Std. 9, there may not be a significant difference between the averages of scores of retention of science context of girls who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 2.723 which was significant at 0.01 level. So this null hypothesis was not accepted. As a result of this, the related twelfth hypothesis was accepted, due to which it can be said that there was a significant difference between the retention of science context of subjects of both the groups involved in the experiment.

➪ **THIRTEENTH NULL HYPOTHESIS :**

In context of the science of Std. 10, there may not be a significant difference between the averages of scores of science achievement of boys who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 2.328 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result of this, the related thirteenth hypothesis was accepted, due to which it can be said that there was a significant difference between the science achievement of subjects of both the groups involved in the experiment.

➪ **FOURTEENTH NULL HYPOTHESIS :**

In context of the science of Std. 10, there may not be a significant difference between the averages of scores of science confidence of girls who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 3.570 which was significant at 0.01 level. So this null hypothesis was not accepted. As a result of this, the related fifteenth hypothesis was accepted, due to which it can be said that there was a significant difference between the science confidence of subjects of both the groups involved in the experiment.

➪ **FIFTEENTH NULL HYPOTHESIS :**

In context of the science of Std. 10, there may not be a significant difference between the averages of scores of retention of science context of boys who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 2.274 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result of this, the related tenth hypothesis was accepted, due to which it can be said that there was a significant difference between the retention of science context of subjects of both the groups involved in the experiment.

➪ **SIXTEENTH NULL HYPOTHESIS :**

In context of the science of Std. 10, there may not be a significant difference between the averages of scores of science achievement of girls who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 2.031 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result of this, the related sixteenth hypothesis was accepted, due to which it can be said that there was a significant difference between the science achievement of subjects of both the groups involved in the experiment.

➪ **SEVENTEENTH NULL HYPOTHESIS :**

In context of the science of Std. 10, there may not be a significant difference between the averages of scores of science confidence of girls who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 2.670 which was significant at 0.01 level. So this null hypothesis was not accepted. As a result of this, the related seventeenth hypothesis was accepted, due to which it can be said that there was a significant difference between the science confidence of subjects of both the groups involved in the experiment.

➪ **EIGHTEENTH NULL HYPOTHESIS :**

In context of the science of Std. 10, there may not be a significant difference between the averages of scores of retention of science context of girls who were taught by computer assisted teaching method and lecture method.

T-tests was used as statistical technique. The acquired t-value was 2.143 which was significant at 0.05 level. So this null hypothesis was not accepted. As a result of this, the related eighteenth hypothesis was accepted, due to which it can be said that there was a significant difference between the retention of science context of subjects of both the groups involved in the experiment.

6.3 CONCLUSIONS OF THE STUDY :

Conclusions of the study on the interpretations obtained at the end of testing of hypothesis designed for the study are as shown under :

6.3.1 The science achievement of boys of Std. 8 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.2 The science confidence of boys of Std. 8 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.3 The science retention of boys of Std. 8 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.4 The science achievement of girls of Std. 8 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.5 The science confidence of girls of Std. 8 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.6 The science retention of girls of Std. 8 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.7 The science achievement of boys of Std. 9 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.8 The science confidence of boys of Std. 9 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.9 The science retention of boys of Std. 9 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.10 The science achievement of girls of Std. 9 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.11 The science confidence of girls of Std. 9 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.12 The science retention of girls of Std. 9 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.13 The science achievement of boys of Std. 10 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.14 The science confidence of boys of Std. 10 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.15 The science retention of boys of Std. 10 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.16 The science achievement of girls of Std. 10 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.17 The science confidence of girls of Std. 10 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.18 The science retention of girls of Std. 10 who were taught by computer assisted teaching method was higher than that taught by lecture method.

6.3.19 There was no effect of variables like standard or sex on the relationship between teaching method and science achievement.

6.3.20 There was no effect of variables like standard or sex on the relationship between teaching method and science confidence.

6.3.21 There was no effect of variables like standard or sex on the relationship between teaching method and science retention.

6.3.22 In context of science achievement, the effect of computer assisted teaching method was more than the lecture method.

6.3.23 In context of science confidence the effect of computer assisted teaching method was more than the lecture method.

6.3.24 In context of science retention, the effect of computer assisted teaching method was more than the lecture method.

6.4 OUTCOME PRODUCT OF THE STUDY :

This research was conducted to examine the effectiveness of computer assisted teaching method at secondary level. So certain units from among the science subjects of secondary school were selected so that computer assisted teaching can be done to them. Different units of Std. 8, 9 and 10 were selected and a required CD of computer was also selected. This CD was presented before the students who were the samples of the study and experiments were conducted.

6.5 IMPLICATIONS OF THE RESEARCH :

In context of the teaching of science subject at secondary level, the six experiments conducted in this study to examine the effectiveness of teaching method on (1) Science achievement (2) Science confidence and (3) Science retention indicate that in comparison to traditional teaching method. If teaching is done through computer assisted teaching method then;

i) The science achievement of the students is enhanced.

ii) The science confidence of the students increases

iii) The retention of science context of the students can be increased.

Various suggestions can be made from these conclusions :

i) If the subject of computer is initiated as a main subject in secondary school, it can be used till the teaching of science with its help becomes possible. Especially, those experiments which are difficult to be demonstrated by an instrument in the laboratory or if it is inconvenient to do so, then such experiment can be shown with the help of the computer.

ii) The units of science in which the teaching can be given through computer assisted teaching method, the students get new experience by the teaching and their confidence and interest can be created in that subject, and as a result of this, the attitude of student towards that subject can be positively developed.

6.6 RECOMMENDATIONS REGARDING FUTURE RESEARCHES :

On the basis of the review of earlier researches, the results obtained at the end of this research and the experiences during the research the researcher is inspired to suggest certain related researches which can be conducted later on.

(1) The effect of computer assisted teaching method on learning interest, learner's attitude and other psychological traits should be examined.

(2) The approach of a teacher towards the subject who teaches through computer assisted teaching method and the approach of a teacher

towards the subject who teaches through traditional teaching method should be compared.

(3) During the teaching through computer assisted teaching method, the type of relationship between slow-learner students and bright students should be examined.

(4) During the pictorial presentation through computer assisted teaching method, whether the student is motivated to learn other units in subject on his own or not, that should be examined.

(5) When the dull children or slow-learning children are taught something through computer assisted teaching method, whether they can learn it better than the traditional lecture method or not, that should be examined.

(6) Whether the computer assisted teaching method is effective in subjects other than science or not ? should be checked.

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APPENDIX

Sr. No.	*Item*	*Agree*	*Neutral*	*Disagree*
1	I feel difficult to learn Science			
2	I am always worried that I may fail in Science			
3	I feel very happy to understand Science practical			
4	To perform practical of Science is very easy for me			
5	again is very tedious for me			
6	I am always prepared to learn Science			
7	To learn Science is not my job			
8	I don't think why students worry to learn Science			
9	To get pass in Science I will have to work hard			
10	I get worried when I decide to learn Science			
11	Science is very easy for me to learn			
12	I get confused while studying Science			
13	I feel so bore in Science period that I remain waiting for the end of the period			
14	To learn new Science law is my job			
15	I am always prepared to learn new laws in Science			
16	I have to take cooperation from my friends while doing homework in Science doing homework in Science			

Sr. No.	*Item*	*Agree*	*Neutral*	*Disagree*
18	I sit and write for the whole time in my Science exam and then get passed			
19	Once I understand the law of Science than it is easy for me to use it in practical purposes			
20	Though it takes a longer period to perform the practical of Science continuously work for it.			
21	When Science teacher is not in class I think to go on stage and teach the students			
22	I always get good marks in Science			
23	I just go through Science and get ready for exams			
24	I like to teach the students who are weak in Science			

પરિશિષ્ટ
વિજ્ઞાન વિશ્વાસ માપન સંશોધનિકા

"વિજ્ઞાન અંગે મારે કહેવું છે"

પ્રયોજક
બારોટ નિદત્ત પ્રભુદાસ

માર્ગદર્શક
ડૉ. જનકભાઈ મકવાણા
ઈનચાર્જ આચાર્ય
દરબાર ગોપાલદાસ શિક્ષણ મહાવિદ્યાલય
અલીઆબાડા

વિદ્યાર્થી મિત્ર,

નમસ્કાર

આ પુસ્તિકામાં વિજ્ઞાન વિશે તમારો શો અનુભવ છે તે દર્શાવતાં વિધાનો / વાકયો છે. તમારે તે દરેક વિધાન શાંતિપૂર્વક વાંચી, સમજી ઉત્તર નોંધાવાનો છે. દરેક વિધાન સામે ત્રણ ખાનાઓમાં સંમત, કંઈ કહી શકું નહીં, અસંમત એમ ત્રણ વિકલ્પો નોંધવામાં આવ્યા છે. તમારે દરેક વિધાનને અનુરૂપ, વિજ્ઞાન વિશે તમારો જે અનુભવ હોય તે મુજબના કોઈ એક વિકલ્પના ખાનામાં '✓' દર્શાવી પ્રતિભાવ આપવાનો છે. પ્રતિભાવ દર્શાવવા માટેનું એક ઉદાહરણ નીચે આપ્યું છે, તે જુઓ.

ઉદાહરણઃ વિજ્ઞાન શીખવાનું આવે એટલે મને તાવ ચડે	સંમત	કંઈ કહી શકું નહીં	અસંમત
	✓		

જો તમારે, કોઈ વિધાન માટે પહેલા આપેલો જવાબ બદલવો હોય, તો જે ખાનામાં '✓' કહેલ છે તેમાં 'X' કરી, બીજા ખાનામાં '✓' કરો.

આ તમારું જ્ઞાન ચકાસવા માટેની પરીક્ષા નથી. આથી દરેક વિધાન માટે તમારો અનુભવ તમે નિઃસંકોચપણે, ગભરાયા સિવાય, સાચો જ આપશો. કેમ કે તમારા જવાબો કોઈને બતાવવામાં આવશે નહીં તેમજ ગુપ્ત જ રહેશે.

વળી, સાચા જવાબોથી તમને જ તમારા અંગે જાણવા મળશે.

બધાં જ વિધાનો માટે ઉત્તર આપવાનો છે. તેથી કોઈપણ વિધાનનો ઉત્તર આપવાનું છોડી દેશો નહીં.

તો કહેવામાં આવે ત્યારે પાનું ફેરવી તમારું કાર્ય શરૂ કરશો.

ધન્યવાદ

નિદત્ત બારોટ

સામાન્ય માહિતી :
નામ :
શાળા :
ધોરણ : વર્ગ :

ક્રમ	વિધાન	સંમત	કંઈ કહી શકું નહીં	અસંમત
૧.	વિજ્ઞાન શીખવામાં મને તો ખૂબ જ મુશ્કેલી પડે છે.			
૨.	પરીક્ષામાં નાપાસ થવાની ચિંતા મને વિજ્ઞાનમાં તો હોય જ.			
૩.	વિજ્ઞાનના પ્રયોગો શીખવામાં મને તો મજાનો ખજાનો મળે.			
૪.	વિજ્ઞાનના પ્રયોગ શીખવા એટલે મારે મન રમત વાત.			
૫.	વિજ્ઞાનનો એકનો એક પ્રયોગ મારા માટે કંટાળાજનક છે.			
૬.	વિજ્ઞાન શીખવા માટે હું તો તૈયાર જ હોઉં.			
૭.	આપણે વિજ્ઞાન શીખવામાં તો બસ હાથ જોડીએ.			
૮.	મને તો વિચાર જ આવે કે વિજ્ઞાન શીખવામાં આટલા બધા ગભરાવું શા માટે જોઈએ ?			
૯.	ઉતીર્ણ થવા માટે મારે વધુ મહેનત વિજ્ઞાનમાં જ કરવી પડે છે.			
૧૦.	વિજ્ઞાન શીખવાનું નકકી કરવું એ મારા માટે ચિંતાનો પ્રશ્ન છે.			
૧૧.	વિજ્ઞાન એટલે સાવ સહેલો વિષય.			
૧૨.	વિજ્ઞાનની ગરબડમાં હું તો ગુંચવાઈ જાઉં છું.			
૧૩.	વિજ્ઞાનના તાસમાં એટલો કંટાળો ચડે કે કયારે બસ બેલ વાગે અને તાસ પૂરો થાય, એમ લાગે.			
૧૪.	વિજ્ઞાનના નીતનવા પ્રયોગ ઉકેલવા એ મારું જ કામ.			
૧૫.	વિજ્ઞાનના નીતનવા પ્રયોગો માટે હું હંમેશા સંમત.			
૧૬.	વિજ્ઞાનનું ઘરલેશન કરવું હોય ત્યારે મારે મિત્રની મદદ લેવી પડે છે.			
૧૭.	પરીક્ષામાં વિજ્ઞાનના પ્રશ્નપત્રમાં મારાથી બેબાકળા બની જવાય છે.			
૧૮.	વિજ્ઞાનની પરીક્ષામાં હું પૂરો સમય બેસું ત્યારે માંડ પાસ થાઉં.			
૧૯.	એક વખત વિજ્ઞાનનો પ્રયોગ ઉકેલી લઉં પછી વાત પૂરી. તેવો પ્રયોગ આવડે જ.			
૨૦.	વિજ્ઞાનમાં પ્રયોગની રીત ભલેને અઘરી હોય. પ્રયોગ પૂર્ણ કરીને જ જંપવામાં મજા છે.			
૨૧.	વિજ્ઞાનના શિક્ષક હાજર ન હોય ત્યારે તેમનો વિજ્ઞાનનો તાસ લેવાનું મને મન થાય છે.			
૨૨.	વાર્ષિક પરીક્ષામાં મારે વિજ્ઞાનમાં સારા ગુણ હોય જ.			
૨૩.	બસ, થોડી એવી તૈયારી કરીએ અને વિજ્ઞાન તૈયાર !			
૨૪.	વિજ્ઞાનમાં કાચા રહેતા વિદ્યાર્થી/વિદ્યાર્થિનીઓને શીખવવાનું મને ખુબ જ ગમે છે.			