Chapter I

INTRODUCTION

1.1 Technology in Education
1.2 Constructivism in Education
1.3 Science Education
1.4 Need and Significance of the Study
1.5 Statement of the Problem
1.6 Meaning and Definition of Key Terms
1.7 Objectives of the Study
1.8 Statement of Experimental Hypotheses
1.9 Methodology in Brief
1.10 Experimental Procedure and Statistical Techniques used
1.11 Scope and Limitations of the Study
1.12 Chapterisation

References
INTRODUCTION

Education is the knowledge of putting one’s potentials to maximum use. Education dispels ignorance and is the only wealth that cannot be robbed. One can safely say that a human being is not in the proper sense till he is educated. This importance of education is basically for two reasons. The first is that the training of a human mind is not complete without education. Education makes man a right thinker. It tells man how to think and how to make decisions. The second reason for the importance of education is that only through the attainment of education, man is enabled to receive information from the external world to acquaint himself with the past and receive all necessary information regarding the present. Without education, man is as though in a closed room and with education, he finds himself in a room with all its windows open towards the outside world.

Mahatma Gandhi has once said that education is the all round drawing out of the best in child and man- body, mind and spirit. This opens immense possibilities. Education should be a process which harmonises a person’s inner reality with the outer world, bringing about a change in both spheres. A seed left on dry soil will soon die, but if put into fertile soil, watered and manured, it eventually grows into a tree and produces sweet fruits. A child has much greater potentialities than a seed, but much depends on the way he is treated.

Tremendous changes are occurring in the world today and all these have influenced the ways and means of education. Without education it
is difficult for an individual to adjust with the changing environment of the modern world. It is a paradox that India is a rich country with full of poor people. Though in the ancient past, India had made notable contributions in various fields like philosophy, agriculture, medicine, etc. during this age of automation, it is like an adolescent in fever and is trying hard to achieve its past glory. According to Alterkar (1957)\textsuperscript{1}, “Education has always been regarded in India as a source of illumination and power which transforms and ennobles our nature by the progressive and harmonious development of our physical, mental, intellectual and spiritual powers and faculties.”

India was a knowledge force to contend with, in the ancient days. This status of the country has to be restored. To quote Dr. Abdul Kalam (1998)\textsuperscript{2} from his Vision- 2000: “A developed India by 2020, or even earlier, is not a dream. It need not even be a mere vision in the minds of many Indians. It is a mission we all can take up and succeed.”

1.1 TECHNOLOGY IN EDUCATION

Education and technology have gone hand in hand with each other from the beginning of time. In early civilizations, education was for the different classes of society. The education in those times dealt with an oral tradition of the transmission of knowledge. As technology has progressed from papyrus and charcoal through slate and chalk, to moveable type for printing, education has evolved and changed to match. Technology has advanced more in the latter half of the twentieth century than in the previous 2,000 years. History has shown that modern economic growth has been
inspired by a rapid and persistent upgrading of technology and scientific know-how. Herschbach (1995) defines technology as “organized knowledge for practical purposes”. Technology, however, as a distinctive phenomenon refers to the use of knowledge, materials, tools, techniques, systems, and sources of power to make life easier and better and to work more productively and efficiently.

Education today faces three challenges- access, quality and cost. The tensions between these vectors make up the triangle of education. When the basic challenges of education are expressed in terms of this triangle, it is clear that traditional methods of teaching cannot meet them. By putting more students in each class, access may go up and cost may come down, but the quality of education will be lowered. Evidence shows that technology can really increase access; improve quality and lower costs, all at the same time.

Winds of change are blowing through our classrooms from several directions. The basic tenet identified in the National Basic Education Scheme - ‘Head, Heart and Hand’ need now to be linked to another ‘H’ - Highways. Information Highways, Websites and Internet are becoming terms of common usage in education (Vishwakarma & Pareek, 2000). Schools are serving a more ethnically, linguistically, and culturally diverse student body than ever before. Studies about education, cognitive psychology, and neurology have offered new insights on how humans learn. And from the market place, the infusion of technology has redefined work skills and society’s expectations about what it means to be an educated person.
Over the past few years, our schools have dramatically increased spending on classroom technology. The National Council for Teacher Education, (1998), suggests that the message of educational technology has to reach the classrooms in the form of its application. According to Weiss (1994), “Technology has been shown to make learning more student-centered and to encourage co-operative learning.” Today, children love learning by doing, discovering, and interacting. Technology makes learning more interesting, enjoyable and interactive for them.

Technology is used to mean a tool or instrument which helps us to organize and accomplish specific tasks and goals. In the words of Rekstan (2000), “Technology is not a curriculum, but a tool for curriculum. Focusing and organizing the curriculum by concepts provide the basis for technology to be used. Concept-based teaching along with technology tools will elevate student thinking and improve overall achievement.”

For technology to serve the purposes of change, it must be tied to a coherent, school-wide instructional agenda. For education professionals, computer networking creates a professional bond between teachers and administrators and ends isolation. For students, a new system of knowledge will enhance collaborative learning, alternative assessment and individualized learning. “Educational technology is now widely valued for its ability to enhance one of the most significant intellectual developments for students: their emerging ability to think abstractly” (Jarrett, 1998). The use of
computers in education paved the way for the introduction of technology in a highway in the teaching-learning process.

1.1.1 Computers in Education

Computers contribute to education as aids in learning and instruction in classroom and as an important tool in research on human cognition. Computers are found to be active partners in the learning process. The most important aspects of computer assisted learning are the interactive nature of computer based learning and the ability to individualise the learning experience to the needs of the learners.

Computers have become an essential classroom tool for the acquisition, analysis, presentation, and communication of data in ways which allow students to become more active participants in research and learning. Meister (1984) remarks “The integration of computers in a school is regarded as successful when computers are used in various subjects by a large proportion of students and teachers”. In the classroom, the computer offers the teacher more flexibility in presentation, better management of instructional techniques, and easier record keeping.

With the introduction of the New Educational Policy in 1986, India has taken initiative for making use of computers in the teaching-learning activities. Instructional work carried out with the help of computers is generally known as Computer Assisted Instruction (CAI). “Computer Assisted Instruction has now taken so many dimensions that it is no longer considered as simple derivative of the teaching machine or the kind of
programmed learning that Skinner introduced” (Hilgard & Bower, 1977)\textsuperscript{10}. CAI plays an important role in the enhancement of teaching and learning of the different subjects in schools.

Currently available technologies, the most important of which are computers, communication systems including the Internet connections, interactive videodiscs and CD-ROM systems, provide a learning environment in which problem solving and intellectual inquiry can flourish.

1.1.1.1 Computers in Science Education

Computers offer students a very important resource for learning the concepts and processes of science through simulations, graphics, sound, data manipulation, and model building. It can motivate, increase engagement, provide immediate reinforcement and feedback. CAI plays an important role in the enhancement of teaching and learning of science subjects in schools.

“Computer simulation offers a replica of the real events of objects” (Balasubramanian & Meera, 2002)\textsuperscript{11}. In the field, the portability of the laptop computer allows students to actively gather and analyze data and take it back to the classroom for in-depth study and the sharing of information. These capabilities can improve scientific learning and facilitate communication of ideas and concepts. Thus, it exemplifies the enhancement of learning effectiveness by utilizing various information technologies and teaching methods. “Well-designed technological systems have the potential not only for impacting the goals of science education but also for providing the means for achieving these goals.” (Hawkins & Pea, 1987)\textsuperscript{12}
1.2 CONSTRUCTIVISM IN EDUCATION

The three Rs - reading, writing and arithmetic are certainly important but offer only a basic foundation for real life. Perhaps the real life Rs of the present millennium should be ‘reasoning’, ‘relating’ and ‘recreating’. Naturally, reading, writing and arithmetic are necessary to learn these three. There is just too much information to expect that students can be filled with a body of cultural knowledge. Instead of covering and memorising a huge collection of specific information, students should know how to access knowledge when they need it.

Constructivism is undoubtedly a major theoretical influence in contemporary education. Constructivism represents a paradigm shift from education based on behaviorism to education based on cognitive theory. The expanded purview of constructivism is apparent in the remarks of Pepin (1998)\textsuperscript{13} that: “this approach holds promise for the pursuit of educational objectives other than those associated exclusively with cognitive development … the constructivist point of view makes it possible to develop a vision of the whole educational phenomena which is comprehensive and penetrating”. Fleury (1998)\textsuperscript{14} writes, “Constructivism is a postmodern theory of knowledge with the potential to transform educational theory”. Constructivism is not just a theory about education; it is a theory about one of culture’s greatest and most enduring achievements, namely science. As Bentley (1998)\textsuperscript{15} says “Indeed as an epistemology, constructivism speaks to the nature of science”.

Constructivism spreads to still further fields. It increasingly presents itself as an ethical and political theory, as well as a learning, a teaching and an epistemological theory. It is said “There is also a sense in which constructivism implies caring – caring for ideas, personal theories, self image, human development, professional esteem, people – it is not a take-it-or-leave-it epistemology” (Watts, 1994). Constructivism is thought to be in a morally superior position to its rivals in learning theory and pedagogy. It offers teachers “a moral imperative for deconstructing traditional objectivist conceptions of the nature of science, mathematics and knowledge, and for reconstructing their personal epistemologies, teaching practices and educative relationships with students” (Hardy & Taylor, 1997).

1.2.1 Constructivism in Science Education

Constructivism has great influence in Science Education. Constructivism is one of the theory of learning which well developed in the recent years and became the most significant and dominant perspective in Science education (Taber, 2006). “The most conspicuous psychological influence on curriculum thinking in Science since 1980 has been the constructivist view of learning” (Fensham, 1992). Tobin (1993) remarked this as “constructivism represents a paradigm change in science education.” A unification of thinking, research, curriculum development, and teacher education appears to be now occurring under the theme of constructivism. Their views are echoed in the words of Scott, Asoko, Driver and Emberton.
“science learning, viewed from a constructivist perspective, involves epistemological as well as conceptual development.”

Driver (1989) has used a constructivist epistemology as a referent in her research on children’s conceptions in science. Children’s prior knowledge of phenomena is an important part of how they come to understand science. Often the interpretation of phenomena from a scientific point of view differs from the interpretation children construct; children construct meanings that fit their experiences and expectations. This can lead children to oftentimes construct meanings different from what was intended by a teacher. Children’s conceptions are their constructions of reality, ones that are viable in the sense that they allow a child to make sense of his environment. By using a constructivist epistemology as a referent, teachers can become more sensitive to children’s prior knowledge and the processes by which they make sense of the phenomena.

1.3 SCIENCE EDUCATION

Science is a search that never ends and is never satisfied. The word “Science comes from the Latin word “Scientia” which means knowledge. Science is not only a body of knowledge but also ‘a way of knowing’. Science is a unique subject in the sense that it places emphasis not only on facts but also on the process of acquiring knowledge and values intrinsic to the processes. Science is fun, exciting, and interesting. Henrie Poincaire in Kelly (1941) remarks “Science is built up with facts as a house is with stones, but a collection of facts is no more a science than a heap of
stones is a house.” Hodson (1990) distinguishes three dimensions to an education of Science – learning Science, learning to do Science and learning about Science.

The purpose of Science is to learn about the universe. The joy of science emanates from the freedom to explore and wonder. However, in order to maximize the probability that in the end we get things right, Science follows sensible guidelines.

- “Science has principles and evidence” is the basis of science.
- Creative flexibility is essential to scientific thinking and theories are central to scientific thinking.
- Science is embedded within the culture of its times.

Understanding how Science works allows one to easily distinguish science from non-science.

Science is a method, process, procedure, and system used to study the physical world. The broad aim of learning Science is to develop an inquisitive mind and a scientific approach to problems. To quote Albert Einstein in Booth (1962), “the object of all Science is to coordinate our experiences and bring them into a logical system”. A critical place for science knowledge is the process of “discernment”. From the young to the old, people constantly examine information and discern its truth. The ability to accomplish this with accuracy using Science can make an individual successful. Miller (1995) argues that the aims of Science Education are to learn something about the body of scientific knowledge, something about the
processes by which that knowledge is generated and something about the manner in which that knowledge is socially constructed.

The growing interest in examining Science classrooms as communities of learning (Roth, 1995) raises the potential for losing sight of the different ways in which individuals experience the same learning context. The National Research Council (1996) recommended that science teachers develop communities of science learners while assuring equity and full participation of the diversity of students in their classrooms. Above all, Science should emerge as something alive, fallible, and therefore exciting. Such a model will meet the wider aims of Science Education, and at the same time is more likely to encourage potential scientists to want to study Science.

1.3.1 Making Science Education Interesting

One of the main challenges of Science Education is helping students become scientifically literate (American Association for the Advancement of Science, 1989).

According to Anand (1977), “Science Literacy should aim at producing citizens gifted with the ability to identify and use the processes of Science that are instrumental in learning how to learn throughout life.” He gives certain views on how to make Science Education interesting. These may be summarized as follows.

i) School curriculum should include certain aspects, typical to a particular place.

ii) Teaching must involve extensive demonstration and experiment.
iii) Learning should be made pupil-centric.

iv) Teaching of Science should be in a way that teachers arouse the curiosity of students about a subject and encourage them to experiment on their own.

v) Technology should be need-based and pupil-friendly.

1.3.2 Importance of Biology

Biology occupies a unique position in the school curriculum. Biology is central to many science related courses such as medicine, pharmacy, agriculture, nursing, biochemistry and so on. It is obvious that no student intending to study these disciplines can do without Biology. These factors, among others, have drawn attention of researchers and curriculum planners towards Biology as a subject in the school curriculum. Biology is the branch of science which deals with the study of living organisms. Each individual is unique, and each group of organism illustrates important and unifying biological principles. This makes Biology a challenging and an extremely broad area of study.

Learning and Teaching Biology is complete only when the students are able to have ‘hands-on’ experience with the living world. Zacharia (1965) remarks, “Biology brings the pupil into intimate contact with living organisms and therefore the child is greatly interested.”

1.3.3 Importance of Molecular Genetics

Molecular Genetics is the field of Biology which studies the structure and function of genes at the molecular level. The emergence of
Molecular Genetics has revolutionised large areas of modern biological and biochemical research work and has had a huge impact on the biotechnology industry.

Molecular Genetics is concerned with the development of biochemical and genetic techniques for handling the complex nucleic acids that constitute the genetic material. With the analysis, interpretation and application of the genome sequence information now available, genomic sequences can be analysed, dissected, recombined and reproduced in ways that formerly appeared impossible.

Genetic Engineering is now a reality and its impact on both science and society will be profound. Genetic Engineering arose from studies on bacterial genes. It is now increasingly being used to study how the environment regulates the expression of genes. Already the application of Molecular Genetics has solved problems in many areas of biological, biochemical and medical research that defied years of effort using conventional methods. Similarly, the application of Molecular Genetics has completely transformed the biotechnology industry, with new possibilities ranking from the treatment of human diseases to the development of new forms of crops. Molecular Genetics is not only the most rapidly developing biological science of this decade, but is also the most promising and exciting science of the next few decades.
1.4 NEED AND SIGNIFICANCE OF THE STUDY

Learning to think and learning to learn are essential skills which are needed to meet the challenges of the knowledge economy. Even though enormous changes have taken place in the field of education, very often teachers prefer to use traditional methods of teaching where students are expected to be passive receptors of the content. As a result, students find it difficult to fully internalise particular contents. This does not help in the realization of the curricular objectives fully. Teachers should be encouraged to use the different methods, models and strategies during the teaching-learning process. This would make teaching as well as learning more interesting and effective, thus helping in the realization of the objectives by calling upon the auditory, visual and tactile senses of the students.

To ensure effective learning, students are required to actively construct knowledge and meaning. To actively construct meaning, students need to be active thinkers during the learning process. Students should also be helped to relate prior knowledge in the existing cognitive structure to the new concepts being learnt.

The acquisition of scientific knowledge is particularly acute for domains in which scientific advances are rapid, phenomena are complex and the amount of information accumulated is daunting. Molecular Genetics is one compelling example of such a domain. Over the past decades, there have been numerous scientific and technological advances in this domain. Consequently, there has been tremendous growth in the understanding of
genetic phenomena and the complex mechanisms that mediate genetic effects. The state of affairs “from an educational perspective is not as encouraging; molecular genetics concepts are difficult to learn as well as to teach” (Lewis & Wood-Robinson, 2000). Current instructional practices in Genetics tend “to focus on memorisation of terms and processes rather than on core ideas and the understanding of the underlying mechanisms.” (Duncan & Reiser, 2007)

The present study is intended to help the students understand the basic principles of Molecular Genetics, with the aid of the three methods of teaching; namely, Computer Assisted Instruction (CAI), Constructivist Model (CM) and Constructivist-Computer Assisted Instruction (CCAI), which are highly relevant to the present day educational scenario. The students find it quite difficult to understand the area of Molecular Genetics. This study is expected to help students to comprehend the particular content with greater ease. The study might also be helpful to curriculum planners and teachers in developing new and more effective learning situations that would make the teaching-learning process interesting and meaningful. As such, the investigator gave much significance to the study.

1.5 STATEMENT OF THE PROBLEM

The present study is undertaken with the objective of comparing the effectiveness of Computer Assisted Instruction (CAI), Constructivist Model (CM) and Constructivist - Computer Assisted Instruction (CCAI) in learning Molecular Genetics at the Higher Secondary School Level.
Hence, the study is entitled as **COMPARATIVE STUDY OF THE EFFECTIVENESS OF COMPUTER ASSISTED INSTRUCTION, CONSTRUCTIVIST MODEL AND CONSTRUCTIVIST - COMPUTER ASSISTED INSTRUCTION IN LEARNING MOLECULAR GENETICS AT THE HIGHER SECONDARY SCHOOL LEVEL.**

### 1.6 MEANING AND DEFINITION OF KEY TERMS

**Comparative study**

Study that attempts to find the similarities and differences between two or more things. *(Merit Students Encyclopedia Dictionary, 1973)*

**Effectiveness**

The degree to which something is successful in producing a desired result. *(Oxford Dictionary, 1996)*

**Computer Assisted Instruction**

Select and present instructional material to students with the use of computers to monitor learning progress or to select additional instructional material in accordance with the needs and pace of the individual learner. *(Longely & Shain, 1984)*

Here, it refers to the material prepared by the investigator based on the particular topic, for imparting instruction to individual students, with the help of computer.
Constructivist Model

Model based on constructivist principles and steps which helps the students to construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences.

Here, the 5E Model of Constructivism is used for imparting instruction to students.

Constructivist - Computer Assisted Instruction.

Present computer assisted instructional material based on constructivist principles and steps which create situations and offer tools that stimulate students to make use of their own cognitive potential.

Here, it refers to the material prepared by the investigator on the particular topic, for imparting instruction to students, in which the students learn cooperatively with the help of computers, internet source and through group discussions.

Molecular Genetics

The branch of Biology that deals with the molecular structure and principles of the units of heredity (Merit Students Encyclopedia Dictionary, 1973)34

Higher Secondary School Level

11th and 12th standards recognized by the Government of Kerala, for imparting instruction to students, after the secondary level and before going for higher studies like graduation.

For the present study, the investigator has selected students of
Plus-1 Level from two Higher Secondary Schools in Thiruvananthapuram district only.

1.7 OBJECTIVES OF THE STUDY

The major objectives of the study are:

1. To develop Computer Assisted Instructional Material on Molecular Genetics.
2. To prepare Constructivist Model lesson transcripts on Molecular Genetics.
3. To develop Constructivist - Computer Assisted Instructional Material on Molecular Genetics.
4. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics at the 11th standard of Higher Secondary Level in terms of pre-test achievement, immediate post-test achievement and delayed post-test achievement.
5. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics with respect to gender.
6. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics with respect to locality.
7. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics with respect to management.
8. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics with regard to the attainment of the Instructional Objective - Remembering.

9. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics with regard to the attainment of the Instructional Objective - Understanding.

10. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics with regard to the attainment of the Instructional Objective - Applying.

11. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics with regard to the attainment of the Instructional Objective - Analysing.

12. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction in learning Molecular Genetics with regard to the attainment of the Instructional Objective - Evaluating.

13. To compare the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist - Computer Assisted Instruction
in learning Molecular Genetics with regard to the attainment of the Instructional Objective - Creating.

14. To study the availability of resources, extent of use and the need for special training to teachers for using Computer Assisted Instruction and Constructivist Model in Biology at the Higher Secondary School Level.

15. To identify the practical difficulties, likely to be encountered by teachers while using Computer Assisted Instruction and Constructivist Model in Biology at the Higher Secondary School Level.

16. To collect suggestions of teachers for the effective implementation of Computer Assisted Instruction and Constructivist Model in Biology at the Higher Secondary School Level.

1.8 STATEMENT OF EXPERIMENTAL HYPOTHESES

$H_1$ When the treatment groups namely; Computer Assisted Instruction (CAI) group, Constructivist Model (CM) group and Constructivist-Computer Assisted Instruction (CCAI) group are exposed to experimental teaching (based on total sample), there will be significant difference among the treatment groups with regard to Immediate Post-test Achievement (IPTA) scores.

$H_1(i)$ When Computer Assisted Instruction (CAI) group and Constructivist Model (CM) group are exposed to experimental teaching (based on total sample), there will be significant difference among CAI and CM with regard to Immediate Post-test Achievement (IPTA) scores.
**H₁(ii)** When Computer Assisted Instruction (CAI) group and Constructivist-Computer Assisted Instruction (CCAI) group are exposed to experimental teaching (based on total sample), there will be significant difference among CAI and CCAI with regard to Immediate Post-test Achievement (IPTA) scores.

**H₁(iii)** When Constructivist Model (CM) group and Constructivist-Computer Assisted Instruction (CCAI) group are exposed to experimental teaching (based on total sample), there will be significant difference among CM and CCAI with regard to Immediate Post-test Achievement (IPTA) scores.

**H₂** When the treatment groups namely; Computer Assisted Instruction (CAI) group, Constructivist Model (CM) group and Constructivist-Computer Assisted Instruction (CCAI) group are exposed to experimental teaching (based on total sample), there will be significant difference among the treatment groups with regard to Delayed Post-test Achievement (DPTA) scores.

**H₂(i)** When Computer Assisted Instruction (CAI) group and Constructivist Model (CM) group are exposed to experimental teaching (based on total sample), there will be significant difference among CAI and CM with regard to Delayed Post-test Achievement (DPTA) scores.
**H₂(ii)** When Computer Assisted Instruction (CAI) group and Constructivist-Computer Assisted Instruction (CCAI) group are exposed to experimental teaching (based on total sample), there will be significant difference among CAI and CCAI with regard to the Delayed Post-test Achievement (DPTA) scores.

**H₂(iii)** When Constructivist Model (CM) group and Constructivist-Computer Assisted Instruction (CCAI) group are exposed to experimental teaching (based on total sample), there will be significant difference among CM and CCAI with regard to Delayed Post-test Achievement (DPTA) scores.

**H₃** When Computer Assisted Instruction (CAI) group is exposed to Computer Assisted Instructional material (based on sub-samples):

i. There will be significant difference between boys and girls with respect to Immediate Post-test Achievement scores.

ii. There will be significant difference between urban and rural school students with respect to Immediate Post-test Achievement scores.

iii. There will be significant difference between government and private school students with respect to Immediate Post-test Achievement scores.
When Constructivist Model (CM) group is exposed to Constructivist teaching (based on sub-samples):

i. There will be significant difference between boys and girls with respect to Immediate Post-test Achievement scores.

ii. There will be significant difference between urban and rural school students with respect to Immediate Post-test Achievement scores.

iii. There will be significant difference between government and private school students with respect to Immediate Post-test Achievement scores.

When Constructivist-Computer Assisted Instruction (CCAI) group is exposed to Constructivist-Computer assisted Instructional material (based on sub-samples):

i. There will be significant difference between boys and girls with respect to Immediate Post-test Achievement scores.

ii. There will be significant difference between urban and rural school students with respect to Immediate Post-test Achievement scores.

iii. There will be significant difference between government and private school students with respect to Immediate Post-test Achievement scores.
**H₆** When Computer Assisted Instruction (CAI) group is exposed to Computer Assisted Instructional material (based on sub-samples):

i. There will be significant difference between boys and girls with respect to Delayed Post-test Achievement scores.

ii. There will be significant difference between urban and rural school students with respect to Delayed Post-test Achievement scores.

iii. There will be significant difference between government and private school students with respect to Delayed Post-test Achievement scores.

**H₇** When Constructivist Model (CM) group is exposed to Constructivist teaching (based on sub-samples):

i. There will be significant difference between boys and girls with respect to Delayed Post-test Achievement scores.

ii. There will be significant difference between urban and rural school students with respect to Delayed Post-test Achievement scores.

iii. There will be significant difference between government and private school students with respect to Delayed Post-test Achievement scores.
When Constructivist-Computer Assisted Instruction (CCAI) group is exposed to Constructivist-Computer Assisted Instructional material (based on sub-samples):

i. There will be significant difference between boys and girls with respect to Delayed Post-test Achievement scores.

ii. There will be significant difference between urban and rural school students with respect to Delayed Post-test Achievement scores.

iii. There will be significant difference between government and private school students with respect to Delayed Post-test Achievement scores.

When the treatment groups namely; Computer Assisted Instruction (CAI) group, Constructivist Model (CM) group and Constructivist-Computer Assisted Instruction (CCAI) group are exposed to experimental teaching (based on total sample):

There will be significant difference among Computer Assisted Instruction (CAI) group, Constructivist Model (CM) group and Constructivist-Computer Assisted Instruction (CCAI) group with regard to the attainment of the Instructional Objectives, namely;

i. Remembering

ii. Understanding

iii. Applying

iv. Analysing
v. Evaluating
vi. Creating

1.9 METHODOLOGY IN BRIEF

Since the present study is to compare the effectiveness of the three methods: Computer Assisted Instruction, Constructivist Model and Constructivist-Computer Assisted Instruction, it is experimental in nature. The research design followed is Pre test - Post test Parallel Groups Design. The Sample consisted of about 232 students of Plus-1 Level from two Higher Secondary Schools in Thiruvananthapuram district in Kerala.

Survey method is used to study the availability of resources, extent of use and the need for special training to teachers and to identify the practical difficulties, if any, likely to be encountered by teachers while using CAI and CM in Biology at the Higher Secondary Level. The sample for survey comprised of 55 Higher Secondary Biology Teachers.

The tools developed by the investigator are:-

i. Computer Assisted Instructional Material
ii. Lesson transcripts based on Constructivist Model
iii. Constructivist-Computer Assisted Instructional Material
iv. Achievement Test
v. Rating Scale for Higher Secondary Biology Teachers
vi. Questionnaire for Higher Secondary Biology Teachers
1.10 EXPERIMENTAL PROCEDURE AND STATISTICAL TECHNIQUES USED

Three groups are randomly selected and a pre-test is administered to the three groups. Group I is taught through Computer Assisted Instruction, Group II by Constructivist Model and Group III by Constructivist-Computer Assisted Instruction. After experimental treatment, an immediate post-test is administered. The achievements of the three groups with respect to immediate post test are taken into consideration. After a period of one month, a delayed post-test is conducted to collect the delayed achievement scores of students and the achievements of the three groups with respect to delayed post-test are also taken into consideration.

The scores obtained by the students in the pre-test and post-tests are classified and subjected to statistical analysis. This includes comparison of mean scores and standard deviation with a view to arriving at a rough estimate of the comparative effectiveness of the treatment groups, followed by more precise comparison using the technique of Analysis of Covariance.

1.11 SCOPE AND LIMITATIONS OF THE STUDY

The study is intended to test the effectiveness of Computer Assisted Instruction, Constructivist Model and Constructivist-Computer Assisted Instruction in learning Molecular Genetics at the Higher Secondary School Level. Computer Assisted Instruction helps to proceed according to one’s own pace and needs. Constructivist Model helps students to construct their own understanding and knowledge of the world, through experiencing things and reflecting on these experiences. Constructivist-Computer Assisted
Instruction presents students with a complex and relevant problem or experience that they accept as a challenge. Computer Assisted Instructional material, internet source and other resource books provide them with the tools and resources that they need to understand the problem and to solve it. Computer Assisted Instruction, Constructivist Model and Constructivist-Computer Assisted Instruction play an important role to improve teaching and learning in Molecular Genetics and develop the research area in Biology education. The teaching strategies informed by the three methods selected are powerful to create meaningful learning process in Molecular Genetics which will help students to understand the concepts of Molecular Genetics through active learning.

The study might highlight the effectiveness of CAI, Constructivist Model and Constructivist-Computer Assisted Instruction in bringing out academic achievements in students.

The study might also help the teachers in making use of the most effective methods in teaching Molecular Genetics. The Computer Assisted Instructional Material prepared would be used for individualized study. The lesson transcripts based on Constructivist Model would be useful to the teachers to create meaningful learning experiences for students in dealing with the particular topic. The Constructivist-Computer Assisted Instructional material can be used for individual or group study.

All the three methods used in the study have great curricular implications also. It is expected that the findings of the study will help policy
makers, educational planners, curriculum framers, text book writers and other people in the field of education to understand the effectiveness and necessity of the application of the three methods in teaching Molecular Genetics.

The investigator has made every attempt to make the study a near perfect one. But, the following limitations have crept into the study.

1. No test was conducted to select the samples.
2. The study was designed to focus on learning of Biology by Higher Secondary students drawn from only two schools in Thiruvananthapuram district.
3. The curriculum content was limited to a single unit - ‘Molecular Genetics’ of the entire Biology curriculum.
4. The instructional materials were prepared only for 5 topics in Molecular Genetics.
5. The use of computers was limited to the presentation of curriculum contents only.
6. Computer assisted materials were prepared without audio facility.
7. The treatment groups were exposed to pre-test and post-tests using paper and pencil approach, instead computerised testing could have been done.
8. Assessment tools like concept maps could have been used to assess the progress of students.

1.12 CHAPTERISATION

This research report has been divided into six chapters.
Chapter I is an introductory chapter and presents a rational background for selecting the topic, the need and significance of the study, statement of the problem, definition of key terms, objectives and hypotheses formulated for the study, methodology in brief along with the scope and limitations of the study.

Chapter II describes the theoretical aspects of Computer Assisted Instruction, Constructivism and Constructivist-Computer Assisted Instruction and gives an overview of Bloom’s Taxonomy and Anderson and Krathwohl’s Taxonomy.

Chapter III offers a detailed review of related studies and recent trends in the field of investigation.

Chapter IV gives an account of the method adopted, variables selected, tools used, sample selected, and procedure adopted in the experiment and the statistical techniques employed.

Chapter V gives the details of the analysis of the data collected along with the interpretation based on the values arrived through the statistical treatment.

Chapter VI deals with the conclusions that have emerged from the study, followed by recommendations and suggestions for further research in the area.

The research report is followed by a fairly exhaustive Bibliography which is followed by a series of Appendices pertaining to the study.
REFERENCES


