Introduction
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CHAPTER 1

INTRODUCTION

1.1. Introduction

Over the years mankind has developed newer technologies as the older ones proved to be insufficient in the light of the needed improvement in the quality of the learning experience. With the introduction of more and more innovations into the system of education, the emerging trend all over the world is towards more individualised and flexible forms of learning with more importance attached to the needs of the individual learners.

Having realised this world wide trend and the significance of the Kothari Commission's observation that the quality of education can be judged by the extent to which Science and Technological findings are used for improving its standards, our educational planners have given the right place to technological inputs in the field of education. The National Policy on Education - 1986 has emphasised the application of Educational Technology to
improve the quality of education at all levels. It has also laid a special emphasis on using computers in Mathematics Teaching.

Many research studies are going on in various centres of higher education regarding the suitability and effectiveness of various innovations in Indian conditions. Those studies reveal that among the different innovations, computer application in education holds a promising future.

1.2. Computers in Education

Computers can be used in an educational environment in three ways:
* to instruct learners
* to assist teachers
* to help in managing the institution

The first two uses are of our interest where the computer is used as a potential tool to aid the teaching-learning process. Here it becomes an effective instructional tool in the hands of an efficient teacher.

As an instructional tool it can play two different roles.

1. Deliver instructions directly to students by allowing them to interact with the learning materials already programmed into the system.

2. Manage information about learner performance and learning resource options in order to prescribe and control individualised lessons.

First role refers to Computer Assisted Learning (CAI) or Computer Assisted Instruction (CAT) and the second role refers to Computer Managed Learning (CML) or Computer Managed Instruction (CMI). The computer can be viewed as a tool for enhancing instruction through Computer Assisted Instruction and instructional management through Computer Managed Instruction. The key point in Computer Assisted Instruction is enhancement of instruction whereas the focus of Computer Managed Instruction is management of instruction. Compared to Computer Assisted Instruction, the Computer Managed Instruction is still in its infancy in the developing countries.

1.3. Computer Assisted Instruction (CAI)

CAI is the natural outgrowth of the application of the principles of programmed learning. It is an instructional
The technique in which the computer is used in the following ways:

(a) to control the presentation of stimuli to the learners
(b) to accept and evaluate the learners' responses and
(c) to present further stimuli based on those responses.

The learner uses a terminal directed by a computer that may be in the same room or some distance away. The terminal is generally equipped with information display and the learner response devices. The most common information display device is the Visual Display Unit which looks like a TV screen. The most common learner response device is the keyboard which has keys similar to those in the typewriter. Computer Assisted Learning therefore, is concerned with the use of computers to mediate in the flows of information in the learning process. These may be flows between the learner and the factual information that he or she must absorb, feedback to the learner on his or her progress, information about a model with which the learner is working, or flows between the learner and his or her teacher. This provides a framework for looking at CAT in more detail, for several different methods and modes of CAT can be identified by considering the way in which the computer is used to mediate the information flows.
1.4. Modes of CAI

Within this medium of CAT, there are a number of modes, which in practice overlap somewhat and are often used in combination. Since the field of computer in education is so recent, it is somewhat difficult to set up categories of modes. Distinctions between categories change as new uses for computers are implemented. The following classification is generally accepted by the educationists:

a) Tutorial  b) Drill & Practice  c) Simulation & Gaming  
d) Problem-Solving  e) Computer-based testing  f) Browsing

a) Tutorial

Tutorial programs present information to the learner, usually by setting up a dialogue with the learner by asking questions. The question may be asked to give an option or to test the understanding of the learner. Depending on the learner's response, the computer might go to new material, repeat the information or branch to less difficult material. Generally, when the learner gives a wrong answer, the computer presents remedial teaching helping the learner understand what is wrong in his/her response. The remedial teaching might consist of
presenting the material in simpler steps. In its simplest form, this tutorial dialogue bears a close resemblance to the programmed learning sequences found in print and on teaching machines in the 1960s. It is reasonable to ask what the computer can add to the material apart from illuminating the text. If that were all, then there could be little benefit in using the computer; a book would be better. However, programmed texts present a number of problems, particularly in determining whether the student has really mastered the current step and in deciding how to branch to the next step. Self-assessment in programmed texts may require the student to make difficult judgements and the routeing may involve complex decisions based on his or her performance and progress through the material to date. This responsibility may make the student's work more, rather than less, difficult.

To overcome this problem, the computer can be used not only to present the learning information but also to determine the students' needs and preferences, and to decide how to branch through the structured material. Thus, the material can be made more complex without adding to the student's burden and the assessment of the learners becomes objective.
b) Drill & Practice

In this type of program, no new material is presented. Instead, facts, ideas, or relationships are practiced by giving a question or other appropriate stimulus to which the user must respond. The program will then tell the user whether the response is right or wrong, perhaps giving a hint and another try, then going to the next question. Drill and practice programs vary greatly in their levels of sophistication, ranging from the unimaginative electronic ditto sheet to elaborate and exciting video games.

c) Simulation & Gaming

In simulation, the learner confronts a scaled-down approximation or simplification or an abstraction of a real-life situation. The simulation program on flying plane gives the user experience in many aspects of flying a plane without any risk. In simulations, participants usually play a role that involves them in interactions with elements of the simulated environment. For example, the computer-based simulation operation 'Frog' allows a student to dissect and reconstruct a frog using the same 'instruments' that would be used in a biology laboratory.
The student must remove the twenty three organs in sequence as in an actual dissection. A large number of civilian and military occupations involve the operation or maintenance of complex equipment such as aircraft, manufacturing machines, weapon systems, nuclear power plants, and oil rigs. Major airlines and the military use computer based simulators to reduce the amount of actual flying time required for training. The navy has reduced pilot training costs through the use of computer based simulation. But the attempts to use simulation in schools are sporadic.

The computer has added a new dimension to game playing. In the days earlier to computer, games generally required two or more people. After the invention of the computers, it is now possible for an 'individual' to play a game against the computer. Since most children find games to be a good motivation, computerized educational games may be used to motivate even the most reluctant learner to learn new concepts, practice previously learned skills, or take tests.

d) Problem-solving

Problem-solving programs fall into two categories, those the learner himself writes and those written by some
one else to help the learner solve problems. In learner-
written programs, the learner defines a problem logically
and writes a computer program to solve it. The computer
will do the necessary calculations and/or manipulations
to provide the answers. In the second category, the
computer is the problem solver. The computer makes the
calculations while the student manipulates the variables.

e) Computer-based testing

Computers can be used to store and file banks of test
items. The test items can be filed by subject content,
objectives measured, and/or level of difficulty. Items in
the bank can be readily updated and modified, new items
added, and old items deleted with minimal effort. From
the pool of test items the instructor can choose the items
to include on an examination, or the computer can be
programmed to select the items, either randomly or
according to specified parameters.

f) Browsing

The last of the six major modes of CAI uses the
computer as a mentor and guide through a range of learning
resources which might, but need not, be themselves based on
a computer. The power of the computer to store, retrieve, and process information is used to help the student as he or she browses through the material, responding to questions about related information, retrieving items which are needed, summarizing statistical data, and suggesting possible lines of investigation that may be of interest. In its unintelligent form, the mode degenerates to the computer-managed learning (CML) routing function.

The six modes of CAI discussed above need not be treated as water-tight compartments. They can be used in a variety of combinations to form the basis for newer outcomes. This gives CAI the ability to match specific learning problems by overcoming the weaknesses in one by the strengths of another. For example, simulation may be supported by some tutorial material and calculation facilities may be found in packages which are predominantly drill and practice.

1.5. CAI as a learning medium

The main strength of the computer as a learning medium is its ability to process information very quickly and accurately. The set of rules - the Computer program which specifies the way in which the information is to be
manipulated - can be very complex, yet the processing can be completed so quickly as to appear almost instantaneous to the learner. This makes it possible for the computer to accept and act upon a variety of different kinds of response from the learner and to provide information in textual, graphical, and animated form. The computer can control and co-ordinate information from other pieces of equipment like a slide projector or videodisc player, and based on the learner's progress through a piece of structured material, it can make sophisticated decisions as to what course to follow next. This gives it an ability to respond to the learner's needs, difficulties, and progress which is very much greater than that of a book or video.

The interactive nature of computer assisted instruction, allowing students to learn at their own pace, high speed personalized responses, the patient, personal manner that can be programmed, personalised instruction response & feedback removing the social stigma of learning slowly or making errors, the record-keeping ability, and the time saving are the other advantages.

The above mentioned attributes of CAI as a learning medium reveal that application of computers in education is
a process of endless experimentation where one discovers how enormous the potentials are in terms of content, technique and flexibility. It is in the hands of those involved in the system of education to make the best use of it. Since human resource development is one of the vital areas of current research, it is necessary to explore the possibilities of computer utilisation for optimum development of human resources. It is here that we need to focus our attention on the underdeveloped human resources in the system of education — the underachieving learners.

1.6. The problem of Underachievement

There are instances of many learners endowed with originality and higher mental abilities scoring very low marks in examinations. This means that the talents of such learners are not adequately developed and it results in wastage of human resource and money. Though this is a universal problem, its magnitude is more in a developing country like India where the teachers of the large sized class rooms plan the classes keeping the average achievers in mind, leaving the high and low achievers at loss. Hence, all efforts should be taken for the optimum development of all learners in order to derive optimum
benefit from the system of education. It is here that the CAI techniques with the potential to take into account the great human diversity in learning, render a helping hand.

An attempt is made in the following pages to develop the theoretical basis of underachievement.

1.7. Theoretical Framework of Underachievement

The term underachievement can be explained in many ways. The terms achievement and aptitude are to be explained in order to introduce the concept of underachievement. Achievement means what the individual has learned to do and aptitude means what a person could learn to do. In other words, in an achievement test our interest is to predict what the individual has learned in the past, and in an aptitude test our interest is to predict what the individual can learn or develop in future. The underachievement can be identified by comparing the actual achievement of the learner with his/her capabilities. When the achievement score is lower than the aptitude score, it is a case of underachievement.

When the academic achievement is below the level of expectation, it is a case of underachievement. Poor performance in the absence of any discernible deficit in the structural apparatus required for learning is commonly described as underachievement. This is the student's level of accomplishment which is below the level of expectation as indicated by comprehensive assessment of his individual potentiality. When a student fails to achieve what he should have, by a significant margin, he is an underachiever.

The terms underachievement and overachievement should not be confused with low achievement and high achievement respectively. Torrance (1962) stated that, in general, underachievers tended to have higher scores on intelligence tests and lower scores on tests of creative thinking than the overachievers. If a student, while possessing high IQ, scores less than what he/she is capable of, he/she is an underachiever. Similarly, a student who possesses low IQ may score more than what he/she is capable of. That is a case of overachievement. The score 80% on a test may denote underachievement where as, one scoring 30% on the same test may be called an overachiever, depending on the individual's potentials.
1.7.a) Defining Underachievement (UA) & Overachievement (OA)

The operational definitions of underachievement in the various research studies are not congruent; same is the case of defining overachievers. In the study of the problems of the researcher in dealing with UA, Peterson concluded that variations in the operational definition depend on the universe to be sampled and the measures of ability, achievement and the discrepancy employed. Thorndike showed that to set the same standard for all while selecting underachievers is a faulty concept of UA.

According to Thorndike and Hagen any discrepancy through which achievement falls below aptitude is a faulty conception of underachievement. A student at a given aptitude score level must be viewed in relation to the average achievement of all pupils at his aptitude level. He should be considered as an underachiever if he falls below that average performance.


5. R L Thorndike, loc. cit.
In general, underachievers are those whose actual achievement is not up to the expected level of achievement. Similarly, overachievers are defined as students whose academic attainment is in excess of expectation formed on the basis of their ability. This definition leads to the question of characterising variables and discovering whether underachievers can be helped to achieve better by exploiting those characteristics.

1.7.b) Incidence of Underachievement

Researchers have not yet found out exactly the extent of underachievement. Their studies have revealed that a certain percentage of underachievement is not unnatural. The range of occurrence of underachievement also differs from one study to the other.

Underachievement is found to depend upon various factors like the sample of the study, the effectiveness of the teacher, the efficiency of the educational institution and sex & residence of the students.

In the study of education of gifted children, Havighurst et al. have suggested that nearly 50% of the best human resources is not developed anywhere near
But Gowan reported that a ten percent under-achievement is a common feature of gifted children.

Farquhar and Payne have suggested that the results obtained by different researchers regarding UA and OA are not comparable because of the varied definitions and techniques employed, the difference in the method of sampling, and the areas of achievement. Depending on the type of definition used, the absolute number of achievers labelled as OA and UA shows vast difference. Gowan feels that there is no accepted standard for measuring UA. Naylor also is of the view that in identifying UA one depends heavily on the empirical relationship between IQ and achievement.


The investigation of Bricklin and Bricklin have shown that 15 percent to 40 percent of all school children fall under the category of underachievers. In the study of incidence of UA at the high school level, Tolor found that the incidence of UA was around 26 percent with the National Educational Development (NEDP) Tests' composite score as achievement criterion. He classified 1263 high school students of suburban community into OA, NA and UA using regression equations.

1.7.c) Methods of Identifying Underachievers

Inspite of the variation in the definition and identification of the underachievers the following steps are common for all the methods of identification of UA.

1. Determination of what is expected of each individual by appropriate means.
2. Determination of the actual achievement.
3. The determination of the point which marks underachievement.


Underachievement is a phenomenon that persists at all levels of achievement. Shaw and McCuen (1957), Frankel (1960) and Wageman (1964) have proved the persistence of underachievement. Underachievement can be identified by comparing the individual's achievement scores and intelligence scores. Along with UA it is possible to identify NA and OA. The following are the methods for classification of students into UA, NA and OA.

(i) Difference between intelligence and achievement relative to standard error of measurement:

The difference between a student's intelligence T-score and achievement T-score is computed. If the difference (positive or negative) falls within the standard error of measurement of the intelligence test, the subject is an adequate achiever. A difference of one standard error or more may be considered as a case of underachievement if the achievement score is less and it is a case of overachievement if the intelligence score is less.

(ii) Comparing T-scores in intelligence and achievement:

In the case of an adequate achiever the intelligence T-score and achievement T-score will fall within one
standard deviation of each other. If the achievement T-score of a student is more than one standard deviation above the mean, while intelligence T-score is only within one standard deviation of the mean, that student is an overachiever. On the other hand, if the achievement T-score is only within one standard deviation of the mean, while his intelligence T-score is more than one standard deviation above the mean, he is an underachiever.

(iii) Comparison of quartile ranks of intelligence and achievement:

Students' quartile ranks of intelligence and achievement are calculated separately. If the quartile ranks in both the tests are the same he is a normal-achiever. If the quartile rank in achievement is above the quartile rank in intelligence he is an overachiever. If the quartile rank in achievement is less than the quartile rank in intelligence he is an underachiever.

(iv) Using Regression Equation:

This method is considered to be the most sophisticated one for identifying UA. A regression equation is developed on the basis of the relation between intelligence and
achievement and a graph is plotted after calculating the standard error of predicted achievement. If the actual achievement score of an individual is more than the estimated score by one standard error of the predicted achievement score or more, he is an OA. If the actual achievement score is less than the predicted score by one standard error of the predicted achievement score or more, he is an underachiever. All others are classified as normal achievers.

1.8. CAI to find a solution for UA

Underachievement is a crucial problem that should be solved so as to enable the society to derive optimum benefit from the system of education. The contributing factors of underachievement should be located and should be reduced to the possible minimum and underachievers should be helped to utilise their potential in full. Otherwise underachievement will continue to obstruct the path towards progress and the talent and resources of the nation will be wasted.

According to Deo the identification of underachievers is not easy and is the reason for the slow progress of research on underachievement compared to the pace of
research on average achievement. Hence more research efforts are needed in the area of underachievement.

Dhaliwal and Saini reported that 44.91, 47.46, 48.31 and 50.85 percent of high school pupils are underachieving in English, Mathematics, Geography and Hindi respectively. This high percentage of UA shows that researches on the educational innovations should be done with special reference to underachievers to evolve suitable strategies to surmount the hitherto unyielding problem of underachievement.

Since CAI has been proved by many educationists to have the successful component of individualisation that takes into account the individual differences, research on CAI with special reference to underachievers is sure to result in some useful guidelines for the future. It was with this objective that the investigator tried to analyse the effectiveness of CAI with special reference to a few selected learner variables.

1.9. a) Statement of the Problem

Effectiveness of Computer Assisted Instruction with special reference to Underachievers

b) Definition of key terms

i) Computer Assisted Instruction

It is an instructional technique where the computer program enables the computer to mediate the flows of information between the learner and the learning material in the learning process.

ii) Underachievers

If the actual achievement score of the learner is less than the predicted achievement score by one standard error of the predicted achievement score or more, he is an underachiever.

1.10. Variables selected for the study

The Treatment variable was the Teaching Technique, namely, i) CAI with Teacher Support System ii) CAI without Teacher Support System and iii) Traditional Teaching. Two types of CAI techniques - one with the teacher support
system and the other without the teacher support system were given to Group I and Group II - the two experimental groups of the sample respectively. Group III - the control group was taught by traditional teaching.

The classification variables were: Sex, Locale, IQ, and Achievement Level of the students. The results were analysed with special reference to underachievers. The Study Habit and Mathematics Study Attitude of the under- and over-achievers were analysed to find out the interaction effect of the same on the experimental factor.

To make any individualised technique truly effective it should be designed in such a way to cater to the individual differences of the learners. Hence, apart from the classification variables, the Study Habit & Maths Study Attitude of the students and Teacher Support System were also analysed so that the outcome of the research will answer the question "What type of learners will benefit from what type of instruction".

1.11. Need and Significance of the study

Need for research on CAI to find a solution to solve the problem of underachievement has already given a
background to the problem selected for investigation. Such research efforts are needed more in Mathematics learning since Mathematics is a subject which is under the strong influence of computers. Mathematics learning is seen to be influenced by computers in 2 ways: One is the way the low, average, and underachieving learners can learn the subject through computers without 'Mathephobia' or cheerlessness and second is the way the high and over achievers can use it for enriched and more difficult learning tasks. Hence, it is found that in Maths instruction, a study on the effectiveness of CAI with reference to different categories of learners is the need of the hour.

Most of the researchers who have analysed the effectiveness of CAI techniques on the maths achievement of the learners have done so with reference to the classification - high, average, and low achievers. In this conventional classification, the point of reference is the average score of the group or a standard norm. But, in an individualised instructional technique like CAI where the aim is to help the learners to progress according to their capabilities, we need a different set of parameters that takes into account the individual's capabilities. In this context, the classification - over-, normal-, and
under-achievers which is based on whether a learner achieves in tune with his/her capabilities, will be a more sensitive one.

Researches (Purushothaman and Stella, 1990; Scofield, 1991; Stella, 1991) have proved that CAT does not lead to significant improvement in the achievement of high achievers. The investigator realised that such findings can not be used to evolve guidelines for individualised techniques due to the inappropriateness of the classification - high, average and low to assess individualised techniques in terms of the high achievers' gain. In that classification the individual's optimum development is lost sight of and a high achiever has a small margin to progress (eg. from 90 to 100) where as the average and low achievers have a wider margin (eg. 55 to 100 & 30 to 100). Obviously most of the high achievers would be already nearing the maximum. Hence, it may not be meaningful to say that the high achievers do not benefit out of CAI. To come to meaningful generalisations about the effectiveness of individualised techniques we should try to answer the question "Does the strategy help the learner to reach his/her maximum?" This becomes possible if we consider the classification - UA, NA and OA.
Further analysis of the Indian Educational Researches reveals the following gaps in the present body of knowledge.

a. To derive optimum benefit from the system of education, every learner should be helped to reach his/her maximum level of attainment. But the researches so far undertaken in this area are meagre and inadequate.

b. Even those few studies undertaken so far have not analysed the effectiveness of CAI with reference to the optimum development of individual learners.

c. There is a dearth of clear-cut guidelines for the further trends and criteria for consideration in the matter of developing CAI material for maths learning.

d. Attempts to overcome the problem of underachievement in Mathematics at high school level through technological inputs with teacher support system are nil.

e. Experiments on "What type of learners will reach the optimum level of attainment through what type of instructional technique" are inadequate.

f. There are no substantial findings on the role of teachers in CAI under Indian condition.
The few studies that have analysed some of the above mentioned aspects have not effectively combined the variables viz. UA in Maths, CAI and the Teacher Support.

Hence, to throw more light on the above mentioned knowledge gaps, the investigator has attempted an experiment to study the effectiveness of CAI with special reference to Underachievers.

1.12. Scope and contribution of the Study

i) The results of this study will throw more light on the means to surmount the problem of underachievement in mathematics at school level which will help us to evolve suitable strategies for computer utilisation in schools.

ii) The non-availability of quality software at a reasonable price and the lack of a sound learning theory behind the production of CAI software call for the involvement of subject teachers in the production arena. Experiments of this kind will encourage more teachers to produce their own software and modify according to the needs of the target group. It will also result in a better co-ordination between subject experts and computer experts and this will reduce the software gap.
iii) Packages of this kind are sure to impart dynamism into maths teaching and thus encourage more learners to remain in the stream and not give it up.

iv) Packages of this kind will save time or effort, or both, and hence will either save the institutions money, or enable the available staff to teach more pupils or handle more specialised courses.

v) The intellectual challenge created in the institution by such inputs will provide opportunities for a critical appraisal of the quality of education and result in more 'local experiments' on CAI applications.

vi) The 'local experiments' on the other hand will help the institutions and the teachers to become less dependent on the technology experts and hence reduce the strain of technology dependency.

In a nutshell, the outcome of this study will throw more light on CAI for underachievers and it will be beneficial to all those who are involved in the system of education - the learners, the teachers and the educational institutions.
1.13. Objectives

In the light of the variables selected for the study, the following objectives were framed:

1. To develop CAI software on the selected topic

2. To compare the effectiveness of CAI over the traditional method with reference to achievement level

3. To find out the effectiveness of the software with special reference to underachievers

4. To find out the impact of teacher support system on the achievement of the experimental group

5. To compare the impact of the two types of CAI on the achievement of the underachievers

6. To find out the relationship between the achievement level and the Sex of the experimental group

7. To find out the relationship between the achievement level and the Locale of the experimental group

8. To find out the relationship between the achievement level and the IQ of the experimental group
9. To find out the relationship between the achievement level and the Study Habit of the experimental group

10. To find out the relationship between the achievement level and Maths Study Attitude of the experimental group

11. To find out the interaction effect of Treatment & Sex on the achievement of the experimental group

12. To find out the interaction effect of Treatment & Locale on the achievement of the experimental group

13. To find out the interaction effect of Treatment & IQ on the achievement of the experimental group

14. To find out the interaction effect of Treatment & Study Habit on the achievement of the experimental group

15. To find out the interaction effect of Treatment & Maths Study Attitude on the achievement of the experimental group

16. To find out the interaction effect of Treatment & Achievement Level(UA-OA) on the achievement of the experimental group
1.14. Hypotheses

To reach the above objectives, the following null hypotheses were formulated:

1. There is no significant difference between the achievement of the experimental and the control groups.

2. There is no significant difference between the achievement of the two experimental groups due to teacher support system.

3. There is no significant difference in the achievement of the underachievers of the sample due to CAI.

4. There is no significant difference between the achievement of the underachievers due to teacher support system.

5. The achievement of the experimental group does not depend on the Sex of the students.

6. The achievement of the experimental group does not depend on the Locale of the students.

7. The achievement of the experimental group does not depend on the IQ of the students.
8. The achievement of the experimental group does not depend on the Study Habit of the students.

9. The achievement of the experimental group does not depend on the Maths Study Attitude of the students.

10. The achievement of the experimental group does not depend on the Achievement Level (OA-UA) of the students.

11. The interaction effect of Treatment & Sex on the achievement scores of the sample is not significant.

12. The interaction effect of Treatment & Locale on the achievement scores of the sample is not significant.

13. The interaction effect of Treatment & IQ on the achievement scores of the sample is not significant.

14. The interaction effect of Treatment and Study Habit on the achievement scores of the sample is not significant.

15. The interaction effect of Treatment and Maths Study Attitude on the achievement scores is not significant.

16. The interaction effect of Treatment & Achievement Level (OA-UA) on the achievement scores is not significant.
1.15. Sample

The randomised block design was followed in the selection of the sample. In such a sampling design, the sample is divided into blocks and items belonging to a particular block are allocated at random to the different groups. Since the identification of UA depends on the aptitude score, IQ was taken as the blocking variable.

The sample consisted of students of Std IX selected from 3 Tamilnadu State Board Schools - 1 rural & 2 urban. From each school 35 Std IX students were selected. Using Farquhar's regression method, the selected students were classified into under-, normal- and over-achievers with respect to two different maths achievement scores. This double classification was done to eliminate the ambiguous cases. Students belonging to the same category in both the classifications alone were selected for the final study. Since IQ was the blocking variable, the size of each IQ block - high, average & low IQ category, was further reduced to the nearest multiple of 3 by the random rejection of a few cases. Students within IQ blocks were allocated at random to 3 groups and thus three groups of size 32 each were formed.
1.16. Methodology in Brief

The three random groups were assigned the three different treatments at random. Data on the student variables viz. Study Habit and Mathematics Study Attitude were collected before administering the treatment. The groups were tested for their achievement level at the end of the treatment and statistical techniques were applied to test the hypotheses framed for the study.

1.17. Tools Used

a) CAI software on "The Language of Sets" developed by the investigator in 1990

b) Achievement test on the selected topic developed by the investigator

c) Culture Fair Intelligence Test - Scale 2 - Form B designed by R B Cattell and A K S Cattell, 1961 Edition

d) Study Habits Inventory constructed and standardised by Dr.B.V.Patel

e) Mathematics Study Attitude Scale developed and standardised by Sundararajan and Srinivasan in 1990
1.18. Statistical Techniques used

a) Regression Analysis for identifying under-achievers

b) 't' test to analyse the differential hypothesis

c) X analysis to test the relationship between variables

d) One way ANOVA to test the superiority of the experimental factor

e) Two-way ANOVA to find out the interaction effect of Treatment and the selected variables viz. Sex, Locale, IQ, Study Habit, Maths Study Attitude and Achievement Level (OA-UA) on the achievement scores of the sample

f) Graphical analysis to find out the interaction effect of Treatment and the selected variables viz. Sex, Locale, IQ, Study Habit, Maths Study Attitude and Achievement Level (OA-UA) on the achievement scores of the experimental group

1.19. Limitations

1. Since developing quality CAI software is time consuming, the study was limited to the teaching of 'The language of Sets'.
2. Due to the vastness of the geographical location, the study was confined to three selected schools.

3. Due to constraints of availability of computers, the urban strata of the sample was limited to schools that had computer facilities.

4. Since administering the software was time consuming, the sample size was limited to 96.

1.20. Organisation of the Thesis

The experimental study is reported in five chapters, the first chapter being the introductory part. The second chapter attempts to provide a review of related literature. The third chapter provides complete details regarding the procedure adopted in the preparation of the computer software. The methodology followed for data collection is also discussed here. The fourth chapter presents the analysis and interpretation of the results. The last chapter provides the summary of the findings, recommendations and suggestions for further research. The Bibliography at the end provides a list of books, journals and reports which have helped the investigator in the formulation and conduct of this research. The appendices provide complete information regarding the tools used.