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CHAPTER - 1

INTRODUCTION

Rationale

Human development is operational through the mechanism of interaction between society and nature. This is characterised by a triangular action of forces representing nature, technology and institutions. It is through this system of interdependence that the overall human development process unfolds itself over space - national, regional or local.

All our educational institutions - primary, secondary, collegiate and research must facilitate in familiarising nature and technology on the one hand and guide the individual in the tradition and culture of the land on the other. They should equip the individual with the basic information and intellectual tools so that he can find his way through a multitude of experiences of life, as well as train him for earning a livelihood in conformity with the norms of general conduct accepted by the community of which he is a member. Hence the priority of educational planning to all other facets of planning is undisputable.

Our education system in the past did indeed produce a Raman, a Bose, a Chandrasekar, eminent Nobel Laurets, Scientists, Teachers, Lawyers, Doctors, Administrators and National Leaders.

To regain and to sustain the same spirit with the futuristic perspectives, the present day education, particularly methods of teaching and learning have to be analysed and advantageous strategies should be followed.
It is time to stop looking somewhere outside the compounds and classrooms of schools and colleges for all the ills and sins that they face. Instead, the educational planners, administrators, the public and the teaching fraternity should determine to realise the responsibilities left in their own hands.

**Importance of Teaching Methods on Student Learning**

Every teacher and educationist of experience knows that even the best curriculum and the most perfect syllabus remain dead unless quickened into life by the right methods of teaching and the right kind of teacher. Sometimes even an unsatisfactory and unimaginative syllabus can be made interesting and significant by the gifted teacher who does not focus his mind on the subject-matter to be taught or the information to be imparted but on his students - their reactions and response. He judges the success of the lesson not by the amount of matter covered but by the understanding, the appreciation and the efficiency achieved by the students. In building up, therefore, a picture of the reorganized secondary school, it is necessary to indicate the kind of methods to be adopted and popularised if the curriculum that is recommended is to develop into the kind of educational medium that we envisage. It is really the function of teacher preparation institutes to introduce these methods in the schools through their trained teachers.

**Objectives of Right Methods**

In discussing the problem of right methods, it is necessary to take a broad and comprehensive view of their objectives which are closely related to the objectives of education. A method is not merely a device adopted for communicating certain items of information to students and exclusively the concern of the teacher who is supposed to be at the "giving end"
Any method, good or bad, links the teacher and his pupils into an organic relationship with constant mutual interaction; it reacts not only on the mind of the students but on their entire personality, their standards of work and judgement, their intellectual and emotional equipment, their attitudes and values. Good methods which are psychologically and socially sound may raise the whole quality of their life; bad methods may debase it. So, in the choice and assessment of methods, teacher must always take into consideration in the students the attitudes and values inculcated in themselves consciously or unconsciously. Whatever impact education has on one aspect of the personality tends to react on other aspects.

The motto of every school and its pupils should be "every thing that is worth doing at all is worth doing well" - whether it be making a speech, writing a composition, drawing a map, cleaning the classroom, or forming a queue. From this point of view, it is more valuable to take up fewer projects and to complete them with thoroughness and efficiency than to attempt a larger number haphazardly and superficially. In this connection, it is well to remember that good work, habits, and skills are not acquired theoretically or in a vacuum: it is proper habits of work and insistence on them in every detail and over a long period of time that create the requisite attitudes and values. Discipline or cooperation, for instance, cannot be instilled into students through lectures or exhortations; they can become a part of an individual's normal technique of life only when he has been given numerous opportunities of participating in freely accepted projects and activities. It is felt strongly that only methods that present concreteness and reality to learning help to break down the barriers between life and learning and between school and the community.
On the intellectual side, the most important objective of teaching methods should be to develop the capacity for clear thinking which distinguishes every truly educated person and has become increasingly important in the modern world of "plural possibilities", where everyone must learn to make up his mind and judge issues and problems without prejudice and passion. It must also form the conscious objective of every single teacher, no matter what subject he is entrusted with. Whether a student is asked to make a speech in a debating society or to write an essay or to answer a question in history, geography, or science or to perform an experiment, the accent should always be on clear thinking and on lucid expression which is a mirror of clear thought. All students cannot become eloquent speakers or good stylists but there is no reason why if proper methods are adopted - every normal student is not able to learn to speak and write in such a way as to convey his ideas lucidly and intelligibly.

Finally, it is desirable that the methods of teaching should expand the range of students' interest. A cultured man is a person of varied interest and, if healthy interests are fostered they will enrich the personality. The normal adolescent is naturally interested in many things and in the classroom, on the play-ground, during excursions and in their social and extra-curricular activities. The intelligent and wide awakened teacher has numerous opportunities to kindle new interest, to expand and strengthen existing ones and to satisfy their innate desire to touch life at many points. It is by exploring different avenues of interest and activities that he can truly discover himself and begin to specialise in due course.
Adaptation of Methods to Suit Different Levels of Intelligence

Having stressed the importance of the methods of teachers, it is necessary to discuss individualised work and instruction in order to train the students in the habit of working independently. If students are trained to do so, it will discourage cramming of information and will certainly make it necessary for the teacher to cover the entire course or teach the whole book through formal-oral lessons. He could then concentrate on the essentials showing the inter-connections of topics and arouse intelligent interest leaving some parts of the course to be studied by the students independently. There will always be certain types of assignment in school programme which can be best carried out on the basis of individual activity. Such training is necessary not only to develop their capacity for independent work but also to adopt instruction to individual differences. These differences are a most significant part of the psychological data with which the teacher has to deal and if he fails to adopt his methods of work and presentation to the psychological needs and mental range of different types of children, he can neither win their interest nor their active cooperation. The present practice of mechanically applying the same methods to average, as well as bright children is responsible for much of the ineffectiveness of the instruction given in schools. The idea of adjusting the curriculum to students of varying abilities should be explored and, what is equally important, methods of teaching should also be similarly adjusted. The brighter children will, for example, be able to respond better to methods involving greater freedom, initiative and individual responsibility than the average children who may require, at least in the early stages, a greater measure of planning and guidance by the teachers.
Balancing Individual and Group Work

A wise teacher must however, balance the claims of individual work with cooperative or group work. In actual life it is just as important to possess qualities of good tempered cooperation, discipline and leadership as to how the capacity for personal initiative and independence work. The former qualities develop best in the context of well-organised group work which is not at present given its due place in schools. The normal basis of work in a large majority of schools is competition - competition for marks and grades and prizes. This has its uses within limits but does not by any means provide the proper training for the art of living in the community. The genuine training of emotional attitudes, and social capacities takes place best in the context of projects and units of work undertaken cooperatively. It is the give-and-take of shared experiences that brings out the quality of leadership, inculcates habits of disciplined work and takes the individual out of his potentially mental and emotional isolation. Another advantage of such projects would be that they will break through the academic isolation of the school and brings it into vital rapport with the life and the activities of the surrounding community.

Different Teaching Methods In Education

Different methods of instruction call for different arrangements of teaching media, and while there is no hard and fast rule. Bloom's three main categories of learning - Cognitive, Affective and Psychomotor - could be used as a basis for deciding the mode of instruction.

Some of the methods of teaching adopted by the present educational scenario are enumerated as follows:
Programmed Learning

Programmed Learning is "an innovative concept in the Indian context" which emerged from the experimental study of the learning process in the psychological laboratory. In the words of Mullick (1988), it is "......the first application of laboratory technique utilised in the study of learning process to the practical problems of education". That is why it is claimed that the origin of model programmed instruction arises from the psychology of learning and not from technology. As a result of the extensive as well as intensive work undertaken in the area, programmed instruction has come to stay and is being increasingly used in most countries of the world.

The Meaning/Concept of Programmed Learning

1. **Method of Self-Instruction**: Programmed learning is popularly understood as a "method of self-instruction, where the learner proceeds through instructional material in short steps at his own pace, receiving immediate knowledge of correctness of his answers".

2. Mankle (1988) has defined programmed learning as "a systematically planned, empirically established and effectively controlled self instructional technique for providing individualised instruction to the learner through logically sequential small segments of the subject matter".

3. In the words of Apter (1968), "Programmed instruction is a method of instruction in which the information to be taught is broken down into small units which are to be presented to the student (usually in a written form) in a carefully planned sequence. Each unit or 'frame' contains not only information but is also terminated with a question."
4. **Integrated Instructional System**: Recent advances in programmed learning have widened its concept. It is now "an integrated instructional system which may employ programmed books, teaching machines, films in various forms, audio-visual devices, simulators and actual apparatus. The instructor himself, trained in formulating objectives and in diagnostic analysis of his teaching results, is an important part of this system". This system also implies a strategy in which various kinds of intellectual, emotional and motor experiences are provided to the learner in a controlled situation through the above mentioned devices, which ultimately result in behavioural modifications.

**Salient Features of Programmed Learning**

The following are the salient features of programmed learning and programmed materials:

1. **Individualised System**: Programmed learning is an individualised system; one person learns at a time.

2. **Auto-Instructional System**: The learner learns through an auto-instructional device. The device teaches, corrects and reinforces without the presence of the teacher. However, the teacher is a part of the system; he is absently present.

3. **Logical Order of the Material**: The instructional material is nearly perfectly programmed. It is presented in a logical sequence. Each new step in the learning process follows naturally and logically each preceding step.
4. **Material presented in minimal Increments**: The material is programmed in minimum increments. Each increment is only a small step in the learning process and thus reduces the possibility of error to the minimum.

5. **Learner's Own Pace of Progress**: In a traditional classroom procedure, an average student sets the pace for the whole class. In programmed system, each learner learns at his individual pace - the average moving slowly, the brighter student learning quickly. The rate of accomplishment is establishment by each student's individual performance.

6. **Instant Check of the Learner's answer**: The student's answer is almost instantly checked against the correct answer which appears by the side of the next question or frame. If his answer is correct, he receives encouragement. The very fact that it is correct, reinforces his learning. If the answer is incorrect, he is helped to locate the reason for his incorrect answer. In the latter case, the learner may be sent to a further teaching item which will clear any misunderstanding.

7. **Intensive 'Validation' before the release of a Programme**: All reputable programmes are the subject of 'validation' before publication. This consists in testing the draft programme on a sample of 'student population' of a similar background and intelligence to that of the target population.

**Cooperative Learning**

Cooperative learning is one of the most useful organisational ideas of small group learning recently developed for changing the educational process, engaging the minds of students, and connecting schooling to the world of work. While collaboration in the classroom is not new, it has only recently
gained serious attention from educational researchers. During the late 1960s, the pioneering workers in the field of education tended to use terms such as small group learning. In the 1980s, the term cooperative learning became more prevalent.

Cooperative learning refers to a set of instructional methods in which students are encouraged or required to work together on academic tasks. Cooperative learning methods may be as simple as having students sit together to discuss or help one another with classroom assignments. Cooperative learning is distinguished from peer tutoring in that all students learn the same material and that information usually comes initially from the teacher rather than from the student.

The basic concept of cooperative learning revolves around active small group learning environments. Students cluster together, discuss topics and learn to take charge of their own learning. Team spirit is stressed as students learn to work together in mixed ability groups. Students work together to accomplish a learning goal and their team is held responsible for each group member's learning. The students' objective is not only to complete a task, but to learn something as a team. The success of one student aids others.

The method of cooperative learning provides an alternative to both traditional classroom instruction and individualised instructional systems. These methods can be applied with all age levels of students, all levels of curriculum from elementary school through graduate level, and all major topic areas of different subjects.
In cooperative learning approach, the concept of effective teaching is often emphasised. As per UNESCO's Teacher Education Package (1991), effective teachers help their pupils to learn by

1. helping them to understand their work.
2. setting work that the pupils can do.
4. giving the class different types of activities.
5. sometimes letting pupils choose what they want to do.
6. expecting the pupils to do well.
7. making the classroom a busy place.
8. having sensible rules and routines.
9. praising the pupils for their efforts.
10. organising schedule so that pupils can get on with their work.
11. getting the pupils to help each other.
12. taking notes of the pupil's progress.

Therefore, the teacher assumes the role of 'facilitator of learning' rather than provider of information.

The Teacher's Role in Cooperative Learning

Traditional goal structures tended to be teacher-centred with the teacher controlling learning by imparting knowledge, maintaining control, and validating thinking. Teachers have traditionally controlled the learning that goes on by knowing the end product of the learning experiences as well as the sequence of activities and procedures needed to achieve the learning goal.
They have also to participate in the management of a variety of services and activities which educational institutions undertake to implement their programme (National Policy on Education, 1986).

Successful implementation of cooperative learning requires deep conceptual understanding of the process by teachers and students. Small-group cooperative learning involves significant changes in the role of the classroom teacher. In the cooperative learning classroom, the teacher is faced with the difficult task of encouraging students to become responsible for their own learning. One of the goals is to have students rely more heavily upon their classmates for assistance in doing a task and evaluating the answers. Only after they have checked with everyone in the group are they allowed to ask the teacher for help.

When the classroom organisation is built on cooperative learning, teachers specify the instructional objectives, provide the appropriate materials, and arrange the classroom to maximise social interaction. Additionally, it is the teacher's job to set the task, explain the cooperative goal structure, observe the student interaction, and help students solve problems. Teachers must also pay attention to the learning process, social relationships within the groups and evaluation of the group products.

In a collaborative setting, the teacher helps children gain confidence in their own ability and the group's ability to work through problems and consequently rely less on the teacher as the sole authority of the source of knowledge. Students are motivated more by the social contact with their peers and by their sense of achievement as they succeed in challenging tasks through the group effort rather than through strict, step by step, teacher direction.
In short, the teachers' role in implementing cooperative learning can be explained in various steps as follows:

step 1: Specifying the objectives for the lesson.

step 2: Making a number of pre-instructional decisions.

step 3: Explaining the students about the learning task, the positive interdependence, and the related instructions for working with each other.

step 4: While students work in groups, the teacher monitors students' effectiveness in completing the assignment and in working together cooperatively. At this stage, the teacher provides task assistance and assists students in increasing their interpersonal and small group skills. Students are expected to interact with each other, share ideas and materials, support and encourage each other's academic achievement, orally explain and elaborate the concepts and strategies being learned, and hold each other accountable for learning.

step 5: Evaluating students' achievement and help them to cooperate well with each other.

**Multimedia**

As our technological society accelerates its rate of change, there will be an increasing need to make our methods of instruction more effective, efficient and appealing. This raises the need for better methods of instruction which are primarily concerned with pedagogic application.

The area of instruction can be viewed as being comprised of five major activities - design, development, implementation, management and evaluation.
Of these activities the discipline of instructional design is concerned with producing knowledge about optimal blueprints, knowledge about what methods of instruction will optimise different kinds of desired outcomes of learning.

Instructional media (multimedia), make use of the power of pictures, words and sounds to compel attention to help an audience understand ideas and acquire information that is too complex for verbal explanation and to help overcome the limitation of time, size and space.

While the advantages of using multimedia have been recognised for a long time, their acceptance and integration within instructional programmes have been slow. The significant contributions often realised out of these multimedia are:

1. The delivery of instruction can be standardised.
2. The instruction can be made more interesting.
3. Learning becomes more interactive through applying accepted learning theory.
4. The length of time required for instruction can be reduced.
5. The quality of learning can be improved.
6. The instruction can be provided when and where desired, if necessary.
7. The positive attitude of students towards what they are learning and to the learning process itself can be enhanced.
8. The role of the instructor can be appreciably changed in a positive direction.

Taken together these eight significant outcomes indicate that, through the use of multimedia, both the efficiency of learning may be enhanced.
Traditionally, plans for instruction most often are made in intuitive fashion and may be based on ambiguous purposes. Subject content is the only basis for planning and only casual attention is given to other details like instructional strategy, etc. It is now recognised that instructional process is complex and that attention must be given to many inter-related factors if outcomes are to be successful.

Methods of Teaching and Personality Development of Students

Personality is looked on as a qualitative rather than a quantitative concept: rich or poor, beautiful or ugly, every individual is considered to have a personality which distinguishes him from other individuals. Personality is the pattern or arrangement of the personality traits in an individual. Teachers should have some broad ideas of the psychology of human personality. The personality factors of pupils do affect their learning and performance in classes, and knowledge of personality characteristics of pupils is needed to give them proper guidance.

Personality is a general or total concept which refers to all the traits (physical, psychological as well as a variety of acquired habitual traits) of an individual - blended or organised within him in a characteristically unique manner and which configuration determines his modes of behaviour and his adjustments to the environment. Such personality characteristics are clearly seen by any observant teacher in his classroom when he recalls how certain pupils are self confident and forthright, others diffident and withdrawn and certain others dogmatic and stubborn. Such personality characteristics will show continuously and persistent behaviour and pupils who exhibit certain modes of such behaviour in the classroom will exhibit the same in their home, or other social situations outside the school.
Factors and Teaching Methods That Determine Personality Development

Personality is the configuration of all of an individual's characteristics and as such includes physical, intellectual, temperamental, emotional and social traits. All characteristic aspects that influence these traits affect the total personality of an individual. Each individual's personality is the resultant of many interacting factors such as genetic structure, biological characteristics, socio-cultural environment as well as other specific life experiences. Besides certain innate factors contributing to personality development, the school environment also plays a crucial role in the total development of the child. The school environment in general, and the classroom atmosphere in particular contribute to the formation of various personality traits. Literature reveals that the evolution of educational methods constantly contributed to the institutional development in the past and its influence is so tangible in the present system too. The most modern technological developments have made the present day learning system different from that of the ancient days. The rapid information growth provided through the mass-media has influenced imitative behaviour among the students for fast learning. Therefore, the teacher in the present day classroom is rather forced to use a variety of approaches in teaching to keep the classroom learning under control. Therefore, there is a positive relationship between the methods of teaching and the personality development of the learners. As schools are providing learning experiences to pupils through various methods of teaching, it is imperative to establish how best each method contributes to the personality development.
As a result of continuous experimentation in many of the educational institutions in and outside India, it has been possible to link five major human values with five facts of human personality and five ideals of education. These broad linkages are illustrated below:

<table>
<thead>
<tr>
<th>Human values</th>
<th>Human Personality</th>
<th>Ideals of Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truth</td>
<td>Intellectual</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Right conduct</td>
<td>Physical</td>
<td>Skill</td>
</tr>
<tr>
<td>Peace</td>
<td>Emotional</td>
<td>Balance</td>
</tr>
<tr>
<td>Love</td>
<td>Psychic</td>
<td>Vision</td>
</tr>
<tr>
<td>Non-violence</td>
<td>Spiritual</td>
<td>Identity</td>
</tr>
</tbody>
</table>

Like the indivisibility of the personality and its integrated nature, the basic human values are interlinked and interrelated. What should be done through our methods of teaching and learning is that ideals of education are to be achieved in total, promoting various facts of human personality in equal measure. Thus the blossoming of human excellence through the pursuit and promotion of intellectual, physical, emotional, psychic and spiritual facts of human personality leads to the growth of human values and emergence of complete man. As the value system of the student is mostly nurtured in the classroom and child rearing practices at home, the teacher plays a vital role in the overall personality development. Therefore, the present study exploring the nature of personality development and the methods of teaching in school becomes a pertinent one in the context of the modern education.
Different Methods of Teaching Science

There are a number of methods which are advocated for teaching science. All methods have some uniqueness within its approach. But any method will be successful only in the hands of good teachers. Though there are many methods of teaching, there is no one best method for teaching science. Each teacher should be resourceful enough to adapt all methods so as to produce best results. Various methods should supplement and complement one another.

The traditional ways of classifying methods of teaching science are:

1. The teacher centred approach
2. The child centred approach

The basis for the classification evidently is the role of the teacher and the taught in the teaching process. Under lecture method (chalk and talk method), lecture demonstration method, the historical and biographical methods and the modern team teaching are covered.

In the pupil centred approach, the laboratory - experimental method, heuristic method, problem solving method, project method, programmed learning, cooperative learning and multi-media learning are included.

Many of these methods overlap in terms of objectives as well as procedures. Some run parallel on many points. The only difference is that one method will stress on one aspect while not neglecting the other desirable factors of other methods.

These methods are not monopoly of science teachers. They are common to all subjects. But the science teacher has scope for practising and synthesising all of them and form his own eclectic methods of teaching.
The rationale for choosing one methodology over another depends upon objectives, content, learners needs, learning principles, instructional resources, teacher competencies, climate in the school and expectations of the community in which the school is located. It is, to a large extent, a personal and individual decision made by the teacher. However, most teachers may find, with experience that there is no single technique always seems to work.

It is necessary to use a variety of techniques to avoid boredom in the classroom in learning science concepts. Some techniques (and strategies), however, seem to be more suitable to achieve particular objectives in a particular class at a particular time.

Moreover, learning to think is the major process goal (among many other goals) of teaching science but it can be hardly satisfied by resorting to a single mode of the teaching-learning process.

Successful teaching of science subjects depends for a considerable part on successful planning. With good planning there exists the potential to improve instruction and make teaching more effective. A successful plan for effective teaching is a flexible plan - one that is well thought out and adaptable to a variety of situations. As mentioned above, organising and coordinating four or five techniques to achieve certain objectives is a "Strategy". Deciding strategies, consisting of a few techniques, is the heart of the planning process for realising the desired learning outcomes.

It is hoped that the modern methods of teaching science can serve a greater variety of students in the challenging and promising educational milieu of the future classrooms.
Need for the Study

Education deals with human growth in mind, spirit, character and effective behaviour. Every aspect of the curriculum taught should serve as the tool to achieve this objective. While the comprehension and mastery of a subject matter is important, progress towards the ulterior goals of instruction should also be emphasised. The formulation of habits and attitudes, cultivation of interest and practising of ideals become bases for the further growth of the learner. Therefore, the teaching-learning process should be designed to inculcate these basic values in the learner.

The ideal that the teachers and the taught are partners in an exciting learning enterprise and are both votaries in the temple of learning must be translated into practice. For making this to happen, constant research attempts are made to find out the effectiveness of methods which can optimise the learning experience of the student and at the same time inculcate values.

In the current educational scenario, three important trends are evident. They are as follows:

1. The first trend is a gradual shift towards a student centred approach to learning, a shift that is aimed at manifesting the individual learning potential of the student.

2. The second is an ever widening realisation that there is more to education than teaching basic facts and principles. This type of education attempts to cultivate the various non-cognitive skills and attitudes that are important for success in later life, this is leading to a much greater use of group learning methods like cooperative learning, pupil-to-pupil learning, etc.
3. The third trend is the long term, and is an almost explosive increase in the use of new information technology based on which we require knowledge through the whole gamut of the multiple media or multimedia approaches.

The heart of education is the student learning and the value of any technology used in education must therefore be measured by its effectiveness to improve learning. But today it is observed that learning in our schools is increasingly impeded by hurdles such as the growing gap between the needs for a better educational environment and shortage of good teachers, and lack of knowledge about the modern instructional strategies.

An ideal learning environment is characterised by many variables. While the dynamism of the teacher plays a crucial role in enhancing learning, factors such as the resources available in the school, size of the classroom, the locality, etc., also have impact on the student learning. Yet another important variable is that of teaching methods. Therefore, the teaching-learning-process in the classroom has to be viewed as a multi-dimensional enterprise. The subject taught also is an important consideration in selecting a method of teaching. Abstract subjects such as science and mathematics require clearly defined methods.

Learning is defined as the change of behaviour but the behaviour should not be confined to cognitive functions alone. In the modern educational scenario which is pre-dominantly overloaded with academic inputs, the factors such as interpersonal relationship, leadership qualities, adaptive behaviour etc., are overlooked. The taxonomy of educational objectives includes cognitive, affective and psychomotor domains. A true learning environment would address the curiosity of the learner in all these areas.
Research studies in the past emphasised the need for inventing specific teaching methods that contribute to development of such values and skills besides academic instruction. Therefore, the investigator attempted to study the impact of teaching methods on the achievement and attitude of students in the learning process. The impact in the context of the study is the investigated with respect to the teaching of science subjects at the high school level.

**Objectives of the Study**

The objectives of the study are clearly enumerated as follows:

The major objectives of the study were:

1. To find out the relative effectiveness of the following four instructional strategies in relation to the achievement of pupils in Science.
   
   a) Traditional or Conventional learning method
   b) Programmed learning method
   c) Cooperative learning method
   d) Multi-media approach

2. To investigate the impact of standard on the achievement and attitude in relation to teaching strategies.

3. To study whether or not there is a difference in the achievement of the students on the basis of gender.

4. To study the attitude changes of the students towards the teaching-learning process as a result of the specific instructional strategy adopted by the teachers.
5. To study the attitude changes of teachers with regard to the teaching learning process in the light of specific instructional strategies.

6. To study the nature of social interaction of students in relation to specific teaching strategies in the classroom.

It is desirable to mention the specific objectives to be achieved at the end of this study. They are stated in the form of research questions as given below:

1. Which teaching method among the four methods adopted for the study contributes to higher achievement in science among the students of high schools in the area of Science?

2. Is there a commonality among the teaching methods with regard to the expected learning outcomes?

3. Is one method of teaching easier than the other in realising the expected learning outcome?

4. Does the standard of the student have an impact on the achievement in science when a particular teaching method is followed?

5. Is there any impact of the standard of the student on the attitude towards learning process when a particular teaching method is followed?

6. To what extent the gender groups differ in terms of achievement in science and attitude in the light of teaching methods? To be precise it is proposed to find out whether or not a particular teaching method is liked by the two gender groups.

7. Does a particular teaching method in science contribute to better social interaction among the students?
8. Is it possible to prescribe a particular teaching method as "The Method" of teaching for achieving the expected learning outcomes?

9. What combination among the teaching methods may contribute to better achievement among the students in science?

10. What combination among the teaching methods may contribute to formation of better attitude among the students?

**Statement of the Problem**

The study is titled as "A Study of the Effectiveness of Various Instructional Strategies on Achievement in Science and Interaction of High School Students in Coimbatore".

**Definitions of terms used in the study**

Education terminologies have different interpretations. In any research in the field of education, it is desirable to define the key terminologies used so that there is no misunderstanding of the theme as well as the results of the study. The following key terms used in the study are defined for clarification.

According to the dictionary of education, academic achievement is the knowledge attained or skills developed in the school subjects, usually designated by test scores or by marks assigned by teachers.

**Achievement**

It refers to the performance of individuals in school or college in a standardised or teacher-made series of educational tests.
Garrison (1964) defines achievement as the attained ability or degree of competence in school tasks, usually as measured by standardised tests and expressed in age or grade units based on norms derived from a wide sampling or pupil performance.

According to the dictionary in Psychology (1962), achievement is defined as the proficiency of performance, generally measured by standardised task or test.

There is a tremendous semantic confusion in the use of such words as methods, strategies and techniques because they are used interchangeably in the educational literature. Basically, there are three methods of teaching: transmission, inquiry and a combination of the two (or eclectic method). A method is an overall procedure or process to achieve certain goals. A teacher follows certain approaches approximating one of the three methods given above.

In the context of the study, the term 'achievement refers to the performance of the students in the academic subjects, particularly in the tests conducted by the investigator for the purpose of the research.

**Strategy**

Techniques of teaching are the day-to-day activities which the teacher may design for a particular lesson. They may include group discussions, projects, the use of a textbook or field tripping.

A strategy is the organisation and coordination of the above techniques to practice the method which would achieve the desired goals.
The Random House Dictionary defines Strategy as "a plan, a method or series of maneuvers or stratagems for obtaining a specific goal or result". Applied to teaching, the term strategy refers to "a plan, method or series of activities designed to achieve a particular educational goal" says David (1976). This definition is adopted by the investigator in the context of instruction given by the teachers in the classrooms.

Learning

Ausubel (1968) defines learning as a relatively permanent change in behaviour as a result of past experience, either produced incidentally or through institutional learning through teaching. The following definitions have been adopted by the investigator in the present research study.

Conventional Learning

Teaching in a conventional learning situation refers to the methods of oral or verbal communication. Traditionally, it refers to mostly the chalk and talk method of teaching or lecture method in which two way communication is very minimum. Here the teacher talks and the class listens; thus the teacher is the only active individual in the class and the pupils are passive listeners. The pupils do not have the patience to listen to the lectures all the time. And it mars the listeners of the pupils.

Programmed Learning

In the words of Apter (1968), "Programmed Instruction is a method of instruction in which the information to be taught is broken down into small units which are to be presented to the student (usually in a written form) in a carefully
planned sequence. Each unit or 'frame' contains not only information but is also terminated with a question.

**Cooperative Learning**

Cooperative Learning is a teaching strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject (Balkcom, 1992).

Cooperative Learning is a classroom strategy in which students work in small groups to improve collaborative skills and help each other to learn academic material (Davidson, 1990).

Cooperative Learning refers to instructional methods in which students of all levels of performance work together in small groups towards a common goal (Slavin, 1982).

**Multimedia**

The American Commission on definition and terminology has defined multimedia as follows:

"Methodology based on the principle that a variety of audio-visual media and experiences correlated with other instructional materials overlap and reinforce the value of each other. Some of the materials may be used to motivate interest, others to communicate basic facts and still others to clear up misconceptions and deeper understanding".
Science

Science is that human endeavour that seeks to describe with increasing accuracy the events and circumstances that occur or exist within our natural environment. (Woodburn & Obourn, 1965).

Science is a cumulative and endless series of empirical observations which results in the formation of concepts and theories being subject to modification in the light of further empirical observation. Science is both a body of knowledge and the process of acquiring and refining knowledge Fitzpatrick (1966).

Social Interaction

Social interaction refers to the behaviour directed towards other people and responsive to the behaviour of others (Adisheshiah and Pavanam, 1974). Green (1972) defines social interaction as the mutual influence that individuals and groups have upon one another in their attempts to solve problems and in their stirring towards goals.

High school students

It means the secondary school students who are following the syllabus prescribed by the Department of Education, Government of Tamil Nadu. The investigator selected only students of Standards VIII & IX for the study. The students were from government, aided, rural and urban schools.

Scope of the study

Any research study is expected to contribute to the field of education. Research studies are continuously carried out in the field of education to accommodate the most recent developments. Educators are constantly baffled by the astronomical growth of ideas as well as methods of handling students in the
classroom. Research in the past mostly aimed at investigating the effectiveness of one method over the other method by keeping the student achievement as the main focal theme. Sporadic attempts were also made to compare more than two or three methods of teaching science simultaneously in terms of their relative effectiveness in the teaching-learning process. But no effort was made to compare the effectiveness of the methods on the basis of the different aspects of the educational objectives. As Sinclair points out, "Education is not just the preparation for life but life itself". Real education goes beyond academic achievement. Development of values, formation of attitudes, interpersonal relationship etc. contribute to the personality development of the individual besides academic achievement. Since the present study is attempted to explore the relationship between the methods of teaching science and number of variables associated with personality traits, the results of the study may be of immense use to the teachers in the classroom on how to mould a student. The results may also be useful to the parents to know how a teaching method in science is linked to the formation of certain attitudes. The results also have some impact on teacher preparation centres in reorganising their curriculum thereby emphasising more relevant topics that are likely to contribute optimum learning experience as well as conducive personality development of the students. The heads of institutes may also be benefitted by the study because the study includes teacher perception too besides students achievement in science and their attitude. Therefore, the results of the study have immediate application in the classroom teaching-learning process. This immediate application aspect makes the study more useful in the present educational scenario.
Delimitations of the study

There can be no study without any limitations. It is the responsibility of the researcher to see that the study is conducted with maximum care in order to be reliable. However, the following limitations could not be avoided in the present study.

1. The study is confined to VIII and IX standards only. Inclusion of other standards would have made the study richer.
2. The present study is confined to the selected schools of Coimbatore region only. This would have been extended to other districts too.
3. School education includes participation of the students in a variety of learning activities related to all subjects like language, mathematics, social science, etc. But this study included only Science subject.

Despite the above mentioned limitations, sufficient care has been taken in selecting the sample, constructing tools, gathering reliable data and applying appropriate analysis procedures, etc.

Research Reporting

This thesis consists of five chapters. The first chapter, which has been just completed dealt with the introduction, objectives and statement of the problem. The second chapter deals with a thorough review of related literature. The third chapter describes the methods and procedure of the investigation. The fourth chapter presents the statistical analysis, results and interpretations. Finally, the fifth chapter gives the findings, suggestions, recommendations and conclusion.