CHAPTER I

INTRODUCTION

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INTRODUCTION

Generally, the teaching-learning process in any nation goes on from one generation to the next in a planned manner. It is believed that the process of teaching-learning aims at transmission of knowledge, imparting skills and formation of attitudes, values and behaviour. It is with a view to identifying the nature of such development that educationists have been trying to analyse the learning process in terms of the requirements of the individual and the society. The behaviourist school of educationists who interpreted development in terms of bringing about desirable changes in the behaviour of the learner, thought of observable specific behaviours classified under three domains of behaviour namely, cognitive, affective, and psychomotor. Thus Bloom (1956) Simpson (1968) and Krathwhol (1964) arrived at what is now famous as the taxonomy of educational objectives. According to them development of an individual is made possible by realising the objectives formulated on the basis of desirable behavioural patterns in all the above three domains. Extending this analysis, Bloom and his associates came forward with the idea of Mastery learning. They showed that if suitable instructional strategies are employed, individual development efficient enough to contribute for social development could be made possible through the realisation of objectives to the maximum possible extent.

Good teaching is difficult to define because the term good is so value laden. What appears to be good teaching to one person may be considered poor teaching by another because each one values different outcomes or methods. One teacher may
run the classroom in an organised highly structured manner, emphasizing the intellectual content of the academic disciplines. Another may run the class in a less structured environment, allowing the students much more freedom to choose subject matter and activities that interest them personally. One observer, because of personal values may identify the first as a “good” teacher, while another observer may come to the opposite conclusion with respect to which teacher is better, again, because of a different set of values. Thus classification of teaching as ‘good’ or ‘bad’ convey little meaning. This may lead one in search of a set of criteria to decide the quality of teaching.

According to Cooper (1990 : 4) “A well trained teacher should be prepared in four areas of teacher competence to be effective in bringing about intended learning outcomes.

1. Command of theoretical knowledge about learning and human behaviour.

2. Display of attitudes that foster learning and genuine human relationships.

3. Command of knowledge in the subject matter to be taught.

4. Control of technical skills of teaching that facilitate student learning"

All these suggest the possession of a repertoire of teaching skills to become an effective teacher. Such a repertoire is necessary if teachers are to be effective with students who have varied backgrounds and learning aptitudes.

There are many styles of teaching, and each teacher’s style should be suited to one’s own person and circumstances. “Possibilities of distinction are inherent in whatever accomplishments the teacher possess in marked degree - broad crudition, specialised mastery of his field, competence in research ability to organise information, skill in exposition, effective individual approach to students, talented group leadership, and
even personal qualities of poise and affability." (Justman and Mass, 1956: 172). Around one or more of these, a characteristic style of teaching may be built by a prospective teacher, but good style cannot be maintained without attention to fundamental conventions.

Essentially every teacher creates one's own style of teaching or methodology of teaching. In terms of one's personality and experience, the purpose and subject matter of instruction, and the students being taught, each follows the procedures one judges suitable, choosing and adapting available techniques or devising when necessary new ones. One may not be able to teach well by copying a method which proved effective for someone else. A method good for one class at one time for certain topic may be a complete failure at another time in another class and for another topic. Some teachers due to their captivating way of teaching, subtle imagination, and flare for teaching gain love and regard of students. But others can benefit themselves with the study of methods. A single method may not be suitable for teaching different classes or different portions of the subject to the same class.

The method used in any situation should be dynamic and not a stable one and should be such as to give a training in the scientific method and developing scientific skills attitudes and appreciation among the pupils. Researches have also shown that effectiveness of educational process depends on the methodologies of teaching and learning adopted at the various stages. It is therefore, imperative on a teacher to be aware of the different strategies of teaching and be able to adopt appropriate strategies to achieve desired objectives.

It seems that "the new technology, like the individualised methods of learning introduced in the 1950 and 1960s, will not replace teachers. Those who are skilled in clear
exposition and in promoting in their student understanding, the will to learn, flexibility and depth in thinking will be equally in demand, or more so than at present." (Beard and Hartley, 1984:7)

Recent teaching models inspired by the views of Carl Rogers stress empathy, an unconditional positive regard of pupils and a genuine sympathetic approach to pupils in promoting a favourable class room climate which will facilitate interpersonal learning. Such a teaching model emphasises the quality of human interaction and the degree of interpersonal intimacy and interaction found in the class room. Ultimately the amount and quality of learning in the class room depends upon the nature of class room climate and the existence of learning situations conducive to the development of such a climate. On an examination of the different teaching models available for emulation, it is seen that each of these has some significance and teaching is not exclusively one or the other. It is equally clear that whatever model a teacher has in view, he or she can and should integrate it with the teaching technology. Teaching model in which there is demand for the learner’s active participation is given particular emphasis. Today’s teachers are to train children to lead a full life in the 21st century. The future of education depends, therefore, directly upon the quality of the intermediary inventive minds of teachers and their ability to invent and innovate. It is in this area that the role of instructional technology assume vital importance and a discussion on the major research studies concerning which follows.

1.1 Innovations in Instructional Practices

The manner in which diverse information can be processed - integrated, reduced to categories, symbolically transformed, stored and subsequently retrieved has long been the focus of artificial intelligence. Such an analysis has helped explicate the processes and knowledge that underlie cognitive endeavour, so improvement may be
made. They have also added an important dimension to the understanding and potential, improvement of teaching and instruction.

The first generation of instructional research was dominated by behavioural research models and skinner's operant learning paradigm. Studies representative of this generation investigated the influence of instructional variations, such as feedback and reinforcement, systematic practice and pacing on student response. Knowledge was gained from such studies about how learning may be maximised under a variety of instructional conditions. But the effectiveness of different instructional manipulations was found to vary across studies, particularly as experimental conditions became more representative of real world situation. Student’s responses are seen to depend on a variety of factors that interact with the nature of instruction. The advent of cognitive psychology has given instructional researchers a way to refine the meanings of terms like student aptitude, teacher characteristics and structural features of subject matter.

Bruce Joyce and Marsha Weil have transformed prevailing theories and theoretical knowledge into different ‘Models of Teaching’. “Teaching is a complex activity, which is a cluster of differing roles and responsibilities. A teacher has to master multiple roles in order to become more professional. The professional competence can be expanded in two ways; first by increasing the range of teaching strategies that are needed to employ; second by becoming increasingly skillful in the use of these strategies” (Joyce and Weil, 1972 :2)

1.2 Importance of Science Teaching

The investigator presents the relative significance of the instructional technologies and the relevance of which in the present day situations. The application of modern technologies is a prerequisite for the instruction of science and applied disciplines. There is a long standing complaint that secondary schools have made no provision for
technical and applied science subjects. To meet this criticism attempts have been made from time to time to revise the curriculum according to the needs of the time. The Indian Education Commission and National Policy on Education-1986 made many recommendations and placed many suggestions for the revision of the curriculum for the future secondary schools. This has become so as applied sciences become an essential subject in the present day classroom and its instruction finds many difficulties and deficiencies at present.

The greatly changing conditions of life and world events are demanding a new perspective for the teaching of science. The ultimate conquest of space travel, the harnessing and hidden sources of energy from outer space, newer and greater uses of atomic energy, automation and related electronic devices and additional developments in antibiotics and other biologicals serve as only a few illustrations of the greater demand for scientific and technical manpower. It is through effective science teaching that an adequate supply of future scientists may be obtained for our national security, health and prosperity of mankind.

Research in modern science is no longer the concern only of the specialists in the various fields of science. "If scientific discoveries were confined within the laboratory walls of scientists and employed only for the intellectual advancement of science no one other than the scientists would be interested in such progress. Advances in science - and particularly the applications to the home, to industry, to agriculture, and to community living - have changed our environment." (Washton, 1961 : 8). As a result, there are different ways and problems of living. Man is continuously striving to adjust himself to an everchanging environment. Applied science is a vital factor in making man modify his behaviour in modern society. Therefore, modern science is
no longer to be thought of as cloistered academic knowledge on the part of pure researchers.

The poor state of science education in India, is reflected in the reviews of the Government of India during 1877-92. Science even did not form a school subject in the beginning of the twentieth century. Indian Education Commission (1964-66) reveals "our science education is really in bad shape and it will become worse if we fail to reckon it with the explosion of knowledge".

The All India Seminar on Teaching of Science (Taradevi Report, (1956) made the following observations about the aims of science education at the secondary level.

1. To familiarise the students with the world in which he lives and the impact of science on society.

2. To acquaint him with scientific method as science should be taught as the discipline of mind.

3. Diversification of courses should be there to facilitate specialisation.

Whatever may be the aim of teaching science, the basis of their formation should be child, society and subject matter. Apart from these aims discussed the most important function of science education should be development of all dimensions of child’s efficiency and this can only be possible if we shift our focus from acquisition of knowledge to development of scientific attitude, reflective thinking, skills, desirable habits, interest in scientific literature and use of science in daily life situations, training for better living, providing opportunities and facilities for specialisation, for vocation etc.
1.3 Importance of Learning Chemistry

It is difficult to draw a strict line of demarcation between Chemistry and other physical and natural sciences. It is closely related to Physics and extending into a variety of other scientific disciplines from Astronomy to Zoology. For example modern Biology has come to rely heavily on the Chemistry of the cells and micro-organisms. Similarly Geology deals partly with the chemical composition of rocks and minerals. “Chemistry is that branch of science, is a method and a habit of thought and that training in skills and teaching technique should be selected accordingly and should be well closely linked with pupils’ emotion and common interests” (New Bury, 1953:14)

But it is observed that schools and colleges in Kerala are mainly concerned with imparting knowledge and carry out even this in an unsatisfactory way. The curriculum transaction places a premium on bookish knowledge and rote learning, make inadequate provision for practical activities and experiences and is dominated by examination; internal and external.

It may be noted that students' achievement in science is mostly influenced by the attitude of the teachers presenting the science experiences and the teachers level of knowledge concerning science processes. According to Lawrenz and Cohen “If teachers knowledge of science process is minimal, then they will be ineffective in promoting the acquisition of science process abilities in their children”. (Lawrenz and Cohen, 1985:95)

It is believed that the present day methods of teaching Chemistry seem to be unsuitable for training the students to have extension of knowledge. This is the age of science and technology. Every activity of the present day world, whether constructive or destructive bears the testimony to the gains and achievements of science. In a developing country like India, the attempt is to achieve better student development through science
education. The development of science has enormously influenced the practical life of man and changed his mode of living and thinking. The aims and objectives of teaching science have been changing continuously in the last few decades. The explosion of knowledge and the consequent changes in curricula and methods of teaching necessitated setting up new goals for science teaching.

1.4 Need and Significance of the Study

The National Policy on Education stresses that "Science education must be strengthened so as to develop in the child some well defined abilities and values like spirit of inquiry, creativity, objectivity, courage to question and aesthetic sensitivity." (National Policy on Education, 1986: 23). It is seen that the students undergo a passive type of learning in the schools and colleges of India which does not help to understand the subject effectively. Due to lack of understanding of the subject, our young future scientists who reach the secondary classes have crammed the content but not 'digested' it, consequently the passive learning continues. Perhaps there is little attempt to change it by bringing in the modern techniques of teaching. The field of Chemistry is wide, its fund of facts, concepts and theories are constantly growing. The content that can be accumulated by rote learning is very limited and will not help in future learning.

An approach to science teaching that places major emphasis on facts is inadequate because it does not present a valid image of the scientific enterprise. A student can experience science only when he is allowed to ask questions about his environment and is given freedom to use his senses to answer these questions. Educational and psychological researches have shown that in the case of young children may experiencing the experiences that the scientist is experienced or being experienced may help in understanding science better.
The lecture method adopted in most of the schools and colleges seems to be irrelevant in the conceptual formation of science subject. If the students are given a kind of first hand experience and suitable explanation and experimentation at the proper time, many of them will incorporate the concepts in their cognitive structure in a meaningful form.

It is revealed that science education provided in educational institutions needs reshaping. With overcrowded classrooms, limited library, limited laboratory facilities and ineffective system of educational practices, the developing countries cannot cope with the increasing scientific knowledge unlike in the developed countries.

It is believed that the prevailing system of education in Kerala fosters only theoretical knowledge. This does not give enough provision for the growing children to meet the demands of day to day life. If a child at a very young age feels that he discovers himself and if his creative urges finds expression in one form or other he becomes more confident about himself and about environment of which he is a part. The educational system provides no direction to creative domain of child and so many talents are left in a seedling form.

The ideal of education has not been the improvement of the individual - the social, intellectual, moral emotional growth of the person - which inevitably leads to social upliftment and human progress. Schools in India have not been able to realise this ideal. Instruction in the present day schools of India is mostly cut and tailored as per teachers’ needs. The teacher seems to be an omniscient giver of truth and knowledge and the student is the inactive recipient of information and ideologies.

It is seen that to train reflective and totally active world citizens, many of the traditional educational practices must be seriously questioned and novel approaches, based on sound objectives must be implemented. Experience has shown that there is no
single way which is said to be the best approach to achieve any instructional objective. Indian schools require a number of ways to create a conducive learning environment. In other words, the class rooms require suitable instructional strategies which help the students to grow socially and intellectually and to develop their personality.

For a long time, teachers have been using a fixed ways of teaching such as explanation according to the Herbartian steps, demonstration, dramatisation, story telling etc. Through the same methods the teacher made his teaching interesting but not effective enough to make pupils develop their cognitive faculties to the fullest extent possible.

Over the years a large number of learning theories have been developed by educationists and psychologists. Such theories of learning alone do not suffice the purpose. Hence based on these theories, researchers have developed a number of teaching strategies to realise specific instructional goals. These teaching strategies show that there is no single best way to teach everything, but different strategies are required to realise different instructional goals. These prescriptive teaching strategies which help to realise specific instructional goals, are known as ‘Models of Teaching’.

A Model of Teaching consists of guidelines for designing educational activities and environments. Models of Teaching are meant for creating suitable learning environments. They provide specifications for constructing learning situations. Each model represents a view on what is important to learn and how it should be learnt. Bruce Joyce and Marsha Weil describe a Model of Teaching as “a description of a learning environment. The descriptions have many uses, ranging from planning curriculum, courses, units and lessons to designing instructional materials - books and work books, multimedia programmes, and computer-assisted learning programmes.” (Joyce and Weil, 1997:11)

Eggen defines Models of Teaching as prescriptive teaching strategies. (Eggen, 1979:12)
Models of Teaching differ from general approaches of teaching in that they are designed to realise specific instructional objectives. General approaches of teaching are considered to be applicable to all teaching situations. These learning strategies are not cure-alls or applicable to all teaching situations. They are rather prescriptive teaching strategies to realise specific instructional goals. For example, to help the children attain concepts there is the Concept Attainment Model, to teach scientific inquiry there is the Inquiry Model. One model is not used to realise all the above objectives. Thus different models or teaching strategies are required to realise different instructional goals.

The investigator who has been a student of Chemistry for long has felt that even such a subject based upon reasoning and thought is being learnt mechanically through memorization of facts, concepts, principles, etc., most of which are often not even understood properly. After familiarizing with the present conditions existing in the educational institutions and the dynamic and innovative programmes suggested by educational thinkers, it was felt that this serious problem could be subjected to an empirical investigation which might throw light to those who are doubtful about their practicability and hence are reluctant to make tryout.

The foregoing discussion reveals that the need of the hour is either the application of modern techniques of teaching or the development of new methods of teaching that result better learning outcomes in Chemistry. The former was found practical as the development of new techniques will take a long time. Of the very few modern techniques of teaching, the Information Processing Models are assumed to be useful in teaching Chemistry in the secondary and the higher secondary schools. Hence the investigator thought of studying the use of this technique in teaching the subject.

As far as the present investigators' knowledge is concerned, Models of Teaching have got about 20 years of use in Western countries. Its use gains momentum.
in India only in recent years. Most of the teachers in Indian schools are still ignorant about this strategy and they are practising certain techniques such as, lecture, lecture-demonstration, heuristic methods etc. (These methods in combination are labelled in the present study as Conventional Methods). It was found necessary to test the comparative effectiveness of this method in the teaching of Chemistry in the secondary and the higher secondary schools of Kerala.

The intelligence of a person can be developed through effective training or education as has been empirically verified by various psychologists. The present investigation tries to find out this method of teaching could do anything in this regard. Likewise whether this method of teaching could do anything in making changes in the Scientific Attitude of pupils.

1.5 Statement of the Problem

The discussion regarding the various strategies of teaching and the prevailing condition of Indian classroom climate revealed the need of a novel approach to teaching. As has been stated earlier the quality of education is deteriorating day by day. Hence it is the necessity of Indian class-rooms to test the effectiveness of Information Processing Models by practising which in the prevailing class room climate. Hence the study is entitled as “APPLICATION OF INFORMATION PROCESSING MODELS IN TEACHING CHEMISTRY AT THE SECONDARY AND THE HIGHER SECONDARY LEVEL”.

1.6 Meaning and Definition of Important Terms

1. Information Processing Models:

Information Processing Models are oriented toward ‘the information processing capability of the students. Information processing refers to the way people handle stimuli from the environment, organise data, sense problems generate concepts
and solutions to problems and employ verbal and non-verbal symbols. Some information Processing Models are to concern with the ability of the learner to solve problems and thus emphasise productive thinking, others are concerned with general intellectual ability. Some emphasise the teaching of strategies derived from the academic disciplines. Again, however, it must be stressed that nearly all models from this family are also concerned with social relationships and the development of an integrated functioning self". (Weil and Joyce, 1978:3)

**Secondary and Higher Secondary Level** is taken to mean the course of study extending classes VIII, IX, X, XI and XII. Higher Secondary level is commonly stated as the 'plus two' stage comprising standards XI, and XII.

### 1.7 Objectives of the Study

1. To compare the effectiveness of the Information Processing Models (IPM) and Conventional Method (CM) in teaching Chemistry for the secondary and higher secondary classes as revealed through the achievement of pupils.

2. To prepare learning materials based on Information Processing Models of teaching in Chemistry for the secondary and the higher secondary classes of Kerala.

3. To compare the effectiveness of the IPM and CM in teaching Chemistry for the secondary and the higher secondary classes as revealed through the achievement of pupils with respect to:
   a.) Knowledge level of cognitive achievement
   b.) Comprehension level of cognitive achievement
   c.) Application level of cognitive achievement
   d.) High Intelligence Categories
   e.) Low Intelligence Categories
   f.) The categories of high achievers on Scientific Attitude Scale
   g.) The categories of low achievers on Scientific Attitude Scale
4. To compare the effectiveness of IPM and CM in developing Scientific Attitudinal changes in pupil.

5. To test whether there is any significant difference in the Scientific Attitude Scores, a.) when IPM is used and b.) when CM is used.

1.8 Hypotheses

1. The attainment of Chemistry of the pupils taught through IPM will be significantly higher than that of those taught through CM.

2. The attainment in Chemistry of the pupils taught through IPM will be significantly higher than that of those taught through CM with respect to: a.) Knowledge level of cognitive achievement. b.) Comprehension level of cognitive achievement. c.) Application level of cognitive achievement. d.) High Intelligence Categories. e.) Low Intelligence Categories. f.) The categories of high achievers on Scientific Attitude Scale and g.) The categories of low achievers on Scientific Attitude Scale.

3. The Scientific Attitudinal changes will be significantly higher for IPM group than that of those taught through CM.

4. There will be significant difference in Scientific Attitude Scores. a.) When IPM is used. b.) When CM is used.

1.9 Methodology in Brief

The method adopted for the present study is Experimental method. Experimental verification is necessary to determine the effectiveness of the Information Processing Models over the Conventional Method of teaching.
In order to conduct the experiment, two divisions each of classes VIII, IX, X, XI, XII reported to be of comparably similar, were selected from N.S.S.G.H.S, Changanacherry, S.H.S., Changanacherry, Govt. Higher Secondary Schools at Karappuzha in Kottayam District and at Kalavoor in Alappuzha District. The first division was considered to be experimental group to be taught through IPM while the second was taught through CM. The units ‘Different Types of Chemical Reactions’ (Class VIII) ‘Oxidation Reduction and Redox Reactions’ (Class IX), ‘Chemical Kinetics’ (Class X), ‘Surface Chemistry’ (Class XI) and ‘Nuclear Chemistry (Class XII) were selected for teaching. Lesson transcripts based on IPM and CM were prepared for each of the unit selected for teaching.

1.10 Tools Used

The most important tool to be developed by the investigator were lesson transcripts according to Information Processing Models. She had also to develop achievement tests to be given as pre-tests and post-tests, for the different classes under study, which is a requisite for applying the statistical technique adopted. A verbal Group Test of Intelligence prepared and standardised by A.S.Nair and others was used to measure the intelligence of the pupils. The investigator prepared and standardised herself a Scientific Attitude Scale and used for assessing the Scientific Attitude of the students. Observation schedules prepared by Joyce and Weil meant for observing the lessons in IPM by the teachers in the school also were used.

The investigator herself conducted the classes for all the two groups of classes VIII, IX, X, XI and XII. Before starting the classes a pre-test developed by the investigator was administered. The classes taken by the researcher were evaluated by the class teachers using the observation schedule supplied in advance, the purpose being
to assess how far the requisites of the specific models were strictly followed by the teacher. When classes were over the post-test was conducted.

The Intelligence Test and Scientific Attitude Scale were also administered on the two groups along with the pre-test. A post-test was also administered for assessing the Scientific Attitude of the groups when the classes were over.

1.11 Statistical Techniques Used

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

1.12 Scope and Limitations of the Study

The major aim of the investigation was to study the effectiveness of Information Processing Models in teaching Chemistry at the secondary and the higher secondary level. The use of the techniques of the selected strategy namely Information Processing Models were explained through the preparation of the lesson transcripts and the effectiveness of the strategy was tested by conducting the experiment. IPM is intended to teach specific types of thinking and also to conceptualise all types of activities. The family constitutes different models like CAM, AOM, ITM etc. CAM is intended to teach specific concepts only. But an understanding of the model will help teachers to identify the conceptual framework of the unit they are teaching. AOM is suitable for teaching concepts. More over it helps to teach inter related concepts. Whereas ITM is to develop the cognitive skills of searching and data processing and the concepts of logic and casuality that they would enable the individual child to inquire autonomously and productively. All these models have curricular application too. It is expected that the findings of the
investigator will help curriculum planners and those who are connected with the educational field, to understand the effectiveness and necessity of the application of these new techniques in the teaching of Chemistry.

There are some limitations of the study. First of all the conducted study was too short - only one unit each from classes VIII, IX, X, XI and XII was taken for writing the lesson plans. The study was confined to only two divisions of classes VIII, IX, X, XI and XII. The study could have been conducted taking more variables of study like scientific interest, SES etc. Due to lack of time, the investigator could not study the curricular application of the different techniques under study. The criterion for achievement in Chemistry was the marks obtained by the students in pre-tests and post-tests. Within the limited time available for the study it was not possible for the investigator to standardise a test of Chemistry achievement to measure all the expected outcomes of Chemistry teaching. Better results would have been obtained, if a standardised test for measuring achievement in Chemistry had been used.

While owning the limitations noted above, the investigator hopes that the findings of the study will be of use to teachers and other educational workers in understanding the application of the new teaching techniques discussed and potentials of these techniques in realising the objectives of teaching Chemistry.

1.13. Organisation of the Report

The report consists of six chapters. This introductory chapter presents an overall view of the topic concerned. It includes a brief account of the innovations in instructional practices, importance of science teaching, importance of learning Chemistry, the need and significance of the study, statement of the problem, definition of important terms, objectives of the study, major hypothesis, methodology in brief, statistical treatment of the data, scope and limitations. Chapter II includes a description of the studies conducted.
in the area of Models of Teaching and also in new instructional strategies applied. Chapter III describes the theoretical background of Information Processing Models in detail. Chapter IV gives the method of study. Chapter V analyses the various components of IPM as applied to the teaching of Chemistry for the classes VIII, IX, X, XI and XII of the secondary and the higher secondary classes, the comparison of each method to conventional method of teaching, using variables like Intelligence and Scientific Attitude of the students and the details of statistical treatment using Analysis of Covariance.

Chapter VI is the concluding chapter, which contains three topic areas. The first is a summary of the objectives of the study, a review of the procedures utilised and summary of the major findings. The second portion is concerned with the conclusions drawn from the findings. The final portion of the chapter presents suggestions for implementation and suggestions for areas of further investigation.
CHAPTER II

REVIEW OF RELATED LITERATURE

2.1 Relevant theories of Instruction
2.2 Instructional Strategies in General
2.3 Models of Teaching