CHAPTER II

REVIEW OF THE RELATED LITERATURE
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2.1. Introduction:

Having discussed the problem on hand and established the need for the study, it is necessary for the researcher to probe into main area of research conducted by other researchers. It serves as a guidepost or a lighthouse.

Turney and Robb (1971) state that the identification of a problem, development of a research design and determination of the size and scope of the problem, all depend to a great extent on the ease and intensity with which a researcher has examined the literature related to the intended research.

Thus, only when a research project is based on all of the relevant thinking and research that has preceded it, it becomes a part of the formulated knowledge in the field and thus contributes to the thinking and research as a whole. It enables us to perceive the gap and lacuna in the field of research concerned.

The studies reviewed have been classified under four headings:

- Studies related to concept attainment model of teaching
- Studies related to Inducing Achievement in Science
• Studies related to retention of science concepts
• Studies related to Attitude towards science.
• Synthesis of Review
• Studies related to concept attainment model of teaching.
• Studies related to Inducing Achievement in Science
• Studies related to retention of science concepts
• Studies related to Attitude towards science.
• Conclusion

2.2. Studies related to concept attainment model of teaching:

Among the four families of models of teaching classified by Bruce Joyce and Marsha Weil (1980) research seemed to have been concentrated on information processing family and less explored is personal models family and “concept attainment model” in particular.

Passi B.K. Singh L.C. and Sansanwal D.N. (1985). Investigated into models of teaching developing training strategy. The objectives were i) To study the effectiveness of training in the concept attainment model in terms of a) understanding of and b) reaction towards model. ii) To study the effectiveness of training in the inquiry training model in terms of a) understanding of and b) reaction toward the model. iii) To study the resultant willingness of teacher educators to implement the model in teacher education programmes.
A purposive sample of 45 teacher educators was taken as subjects of the study. The findings were i) Training in CAM did bring significant change in teacher educators’ reaction towards CAM. ii) The level of understanding of CAM did not influence teacher educators’ reaction towards CAM. iii) Training in CAM in the form of lecture, demonstration, discussion and peer practice plus feedback did enhance the understanding of teacher educators’ theoretical aspects of CAM.

Passi, B.K. Singh L.C., and Sansanwal D.N. (1986). Investigated on adapting training strategy and studying affectiveness of different variation in the components of training strategy for concept attainment model, inquiry training model in terms of understanding, competence, reactions and pupil liking.

The objectives of the study related to CAM were i) to compare the competency in the beginning of coaching in school of student teachers belonging to E1, E2 and E3 groups. ii) To compare the competency at the end of coaching in school of student teachers belonging to E1, E2 and E3 groups. iii) To compare the reactions towards CAM of student teachers (as practising teachers) belonging to E1, E2 and E3 groups. iv) To compare the willingness to implement the model of student-teachers belonging to E1, E2 and E3 groups. The study employed the pre test-post test single group design. Some of the major findings related to CAM were i) the student teachers of E1, E2 and E3 groups attained differential competency
in the beginning of the coaching in school. The student-teacher of the E₂ group had significantly higher competence in the beginning of the coaching stage as compared to those of E₁ and E₃ groups. On the other hand both E₁ and E₂ groups had competency in the beginning of coaching stage to  ii) The student teachers of E₁, E₂ and E₃ groups attained differential competency at the end of the coaching in the school. iii) Student-teacher of E₁, E₂ and E₃ groups had favorable reaction towards CAM.

Passi B.K. Singh L.C. and Sansanwal D.N. (1986). Investigated in to implementing training strategies and studied effectiveness of different variations in components of training strategy for concept attainment model inquiry training model in terms of understanding, competence, reactions and willingness of student-teacher.

The objective of the study for concept attainment model were i) to compare understanding of student teachers belonging to the standard model treatment group (E₁) the group having variation in Peer Practice Feed back (PPF) (E₂) and the group doing PPF in pairs (E₃).  ii) To compare the competency in the beginning of PPF of student teachers belonging to E₁, E₂ and E₃ groups. iii) To compare the competency at the end of PPF of student-teacher belonging to E₁, E₂ and E₃ groups.

The study employed pre-test and post-test parallel group design. Some of the major findings related to CAM were i) the student-teacher
belonging to E₁, E₂ and E₃ groups had differential understanding of the theoretical aspects of CAM. More specifically the student-teachers belonging to the E₂ group and significantly higher understanding of theoretical aspects of CAM as compare to student-teachers of E₁ and E₂ groups. On the other hand student teacher of E₁ and E₂ groups had understood the same theoretical aspects of CAM to the same extent.

Gangrade (1987) compared the effectiveness of a combination of concept attainment model (CAM) and lecture method, with traditional method of teaching science to class VII and VIII students. The results revealed that combination of CAM and lecture method was significantly superior to traditional method in teaching Physics to class VII and VIII students.

Sushma (1987) investigated the effect of Concept Attainment Model (CAM) and Biological Science Inquiry Model (BSIM) for teaching biological science on achievement and attitude towards science and also compared their effectiveness. Both the models were found effective. The CAM was found to be more effective when compared with BSIM and BSIM found to be more effective than conventional teaching with reference to changing the attitude favorably and improving their achievement level.

and found it to be effective.

**Zacharia** (1989) made an attempt to find out the effectiveness of concept attainment model in teaching Economics to standard VIII students. She found that concept attainment model was more effective than traditional method in teaching Economics.

**Chaudhury K.** (1989). Investigated and found that the teaching skills and competencies developed among student teachers through the use of CAM are easily transferable in other teaching situations besides the teaching of concepts. This study also recommended the use of CAM instead of spending much more time on the micro teaching techniques to develop teaching skills.

**Bhaveja B.** (1989a, 1989b.) In her two studies compared the effectiveness of CAM with Taba’s inductive thinking model in regard to the concept learning in Biology and also analyzed the thinking strategies used by the learners. The two studies differed in their sample population and elaboration. The findings were quite similar in the two studies supporting the role of inductive thinking process in the process of conceptualization and generalization.

**Singh D.K.** (1990) studied on the inquiry training model involved its comparison with the concept attainment model. He found that both the models are equally effective in the teaching of physical science to class IX pupils.
Jamini N. (1990) aimed to investigate the relative effectiveness of AOM and CAM on conceptual learning efficacy and retention of chemistry concepts in relation to divergent thinking indicated that although both AOM and CAM were equally effective in fostering concept learning. The AOM was comparatively more beneficial in concept learning to pupils with high divergent thinking. While CAM was more beneficial to pupils with low divergent thinking. The AOM was found to be more effective than CAM in the retention of concepts irrespective of the level of divergent thinking of the pupils.

Sood K. (1990) compared the effectiveness of AOM and CAM for acquisition of language concepts in relation to cognitive style, intelligence and creativity reported that CAM was more effective than AOM in teaching of concepts in Hindi. Intelligence, creativity levels and cognitive styles were redundant factor as far as the learning of concept concern.

Joseph (1990) compared the effectiveness of concept attainment model (CAM), advance organizer model (AOM) and traditional method (TM) in teaching physics to 8th standard students. It was found that CAM was most effective in teaching concepts. Also CAM and AOM are more effective in teaching physics than the (TM).

An elaborative three phase experimental study of CAM and ITM was conducted by passi B.K.Singh L.C and Sansanwala D.N., (1991)
under the guidance of Bruce Joyce aimed at finding the efficacy of the training strategies adopted for training application in Indian classroom conditions. This was a workshop based study on development of training in CAM and ITM. Which brought about significant favourable changes in the attitudes of both the teacher educators and the student teachers towards the model.

Manocha V. (1991) Studied reception as well as selection strategies in comparison to the conventional method for teaching of concepts in Biology. The findings indicated no significant difference between reception and selection strategies with respect to achievement scores.

Kaur R.P. (1991): Jaimini N. (1991) are aimed at comparing effectiveness of AOM and CAM in relation to the creativity of the students. Found that for teaching of concepts in economics both the models are effective and that AOM more effective than CAM. The interaction between teaching strategies intelligence and creativity were not found to be significant.

Bawa M.S. Study (1991) attempted to review the research possibilities on conceptual learning (Bruner's view) and indicated that there is a dearth of research students in the area of concept learning.
Khan M.S. and Siddique M.H. (1992) studied the effectiveness of concept attainment strategies came up with findings that i) Concept attainment strategies were more effective over the traditional approach. ii) Personality factors had no significant effect on the concept attainment process. iii) These strategies were responsive to the needs of disadvantaged learners. iv) Attainment of disjunctive concepts is more difficult than the attainment of conjunctive concepts.

Mahajan J.S (1992) Findings indicated that during the peer group sessions as well as classroom teaching sessions, the group taught by CAM was found to be superior to group taught by AOM as well as routine method as far as the teaching ability of student teachers was concerned.

Mohanty B.K. (1992) JIM was compared with CAM in development of moral concepts and judgement and the personal values of class VIII pupils. The findings of the study indicated JIM was more effective for developing the moral judgement and personal values of students where as CAM was effective in developing moral concepts.

Naresh Kumar Gupta (1995) studied the relative effectiveness of some Information Processing Models of teaching i.e. Concept Attainment Model (CAM), Inductive Thinking Model (IThM) and Inquiry Training Model (ITM) on mental processes and attitudes towards science.
It was found that CAM was effective in developing reasoning ability, scientific creativity where as it could not foster inquisitiveness, persistency of problem awareness among the students. Inductive Thinking Model promoted reasoning ability, scientific creativity, and problem awareness ability but could not bring significant enhancement in inquisitiveness. ITM was effective in developing reasoning ability, scientific creativity, problem awareness ability, however it could not bring significant gain in inquisitiveness and persistency. CAM, ITM and Inductive Thinking Model did not differ in effectiveness in terms of enhancing reasoning ability or scientific creativity. ITM and Inductive Thinking Model rated better than CAM in fostering problem awareness ability However Inductive Thinking Model and ITM did not in fostering seeing the problem ability.

Rajindar Pal Kaul Sidhu (1997) conducted a study on transforming the learning process through teaching models. He found out that,

The achievement in concept learning occurring through teaching by Bruner’s Concept Attainment Models, Ausubel’s Advance Organizer Model and conventional method shows the significant difference and also there is a significant independent effect of different teaching techniques on the scores of subjects on criterion test for the attainment of concept in Economics of Eleventh class students.
Rajinderpal Kaul Sidhu and Parminder Singh (2005) investigated “Comparative study of Concept Attainment Model, Advance Organizer Model and Conventional method in teaching of Physics in relation to Intelligence and Achievement motivation of Ninth class students”.

The objectives of their study were

1. To Study the effect of Bruner’s Concept Attainment Model on scholastic achievement as compared to conventional method of teaching in physics in relation to intelligence and achievement motivation;

2. To study the effect of Ausubel’s Advance Organizer Model on scholastic achievement as compared to conventional method of teaching in Physics in relation to intelligence and achievement motivation;

The Hypotheses of their study were

1. There is no significant difference in the efficacy of Bruner’s Concept Attainment Model, Ausubel’s Advance Organizer Model and conventional method of teaching for learning of concepts in Physics;

2. There is no significant independent effect of intelligence on the gain scores of subjects for learning of concepts in physics;
The tools used for their study were

Meenakshi’s Socio-economic Status Scale, Jalota’s Verbal group Test of General Mental Ability, Achievement Motivation test of Pratiba Deo and Asha Mohan, Lesson plans and a criterion test in physics.

The findings of their study were

1. Bruner’s concept attainment model and Ausubel’s advance organizer model were almost equally effective;

2. Bruner’s concept attainment model was more effective than conventional method of teaching;

Shamnad N. (2005) conducted a study on the effectiveness of Concept Attainment Model on achievement in Arabic grammar of standard IX students.

The objectives of the study were

1. To prepare instructional materials for teaching Arabic Grammar in standard IX based on Concept Attainment Model.

2. To find out the effectiveness of Concept Attainment Model in teaching Arabic Grammar.

3. To compare the effectiveness of Concept Attainment Model with the Conventional Method in teaching Arabic Grammar.
Hypotheses formulated for the study were:

1. There is significant difference in Achievement of Arabic Grammar between the IXth standard students taught using the Concept Attainment Model and Conventional Method.

2. There is significant difference in Achievement of Arabic Grammar between the IXth standard students taught using the Concept Attainment Model and conventional Method under the categories of instructional objectives namely, knowledge, understanding and application.

Findings of the study were:

1. The Concept Attainment model is more effective than Conventional Method in teaching Arabic Grammar in standard IX.

2. The Concept Attainment Model is more effective than Conventional Method in teaching Arabic Grammar under the Objective-knowledge.

3. The Concept Attainment Model is more effective than Conventional Method in teaching Arabic Grammar under the objective – understanding.

4. The Concept Attainment Model is more effective than Conventional Method in teaching Arabic Grammar under the objective-Application.
Raj Rani Agrawal (2006) conducted a study on the effect of teaching strategies in relation to Creativity on Conceptual Learning of class XI students of commerce.

The Specific objectives of her study were

1. To compare adjusted mean learning scores of the students belonging to Advance Organizer Model, Concept Attainment Model and Conventional Method by taking Intelligence and Pre-test as covariates.

2. To compare adjusted mean learning scores of the students belonging to Advance Organizer Model, Concept Attainment Model and Conventional Method by taking Intelligence and Post-test as covariates.

3. To study the effect of treatment, creativity and their Interaction on concept learning of students.

The Hypotheses of her study were

1. There is no significant difference between the adjusted mean learning scores of the students taught through Advance Organizer Model and Concept Attainment Model when compared separately with the Conventional Method and also when inter-model comparison is made.

2. There is no significant difference between the mean learning scores of the students belonging to high creative group and that students
belonging to low creative group when taught by Advance Organizer Model, Concept Attainment Model and Conventional Method, respectively.

3. There is no significant difference between the adjusted mean retention scores of the students exposed to Advance Organizer Model and Concept Attainment Model when compared separately with that of those exposed to Conventional Method.

**The tools used for her study were**


2. Baquer Mehdi’s test of Creativity Thinking (verbal and nonverbal tests). This test measures the creative potential in terms of fluency, flexibility, originality and elaboration.

3. Concept Attainment test, to measure the knowledge, comprehension and application of concepts in commerce. It was developed by the investigator herself.

**The findings of her study were**

1. The Advance Organizer Model and the Concept Attainment were found more effective than the conventional method in fostering concept learning.

2. Concept Attainment model was found more effective than the conventional method in the measure of concept retention.
3. There was no significant difference between the Advance Organizer model and the Conventional method in the measure of concept retention while both were found equally effective in the measure of concept leaning of class-XI students of commerce.

Sunila Bhalla Mehan, (2007) conducted a study on enhancing environmental awareness of schoolchildren.

In the present article this approach has been adopted with certain modifications. Here the teacher plays a pivotal role in the teaching learning process of the classroom. Lesson plans have been prepared beforehand. Objectives of the lesson in behavioural terms have been incorporated in the plan. The teacher has attempted to evaluate the attainment of the knowledge by the students at different stages of the lesson.

Objectives:

The present article was written with the following objectives in mind:

1. To provide every student with opportunities to acquire the knowledge about the environment its protection and improvement.
2. To observe and create new patterns of behaviour in the society for better adjustment according to the environmental needs.
3. To foster a clear concept about economic, social, political and ecological areas of environment.
**Design-sample and tools of study:**

The study comes under the experiment method of research. In this study control group pre-test-post test design was followed. Three groups of the subjects work were considered. There were only girl students of elementary classes—6th, 7th, and 8th. Three sections were considered. Each section had 40 subjects. Two groups were treated as experimental groups and the third group as control group. One of the two experimental groups was taught environment related topics by Concept Attainment model and the second group was taught by Inquiry Training Model and the third group was taught by Conventional Model (Traditional Model). The topics were selected from three subject only—general science, social studies and English language. The selected topics were concerned with the environment directly or indirectly.

**Results and finding:**

Analysis of data revealed that pre-test scores of three classes did not differ much significantly in environmental awareness of initial behaviour among the three groups of the samples.

Observation of data of 6th class indicated that most significant change in environmental awareness comes through Inquiry training model. The second higher change comes by teaching the student in traditional model. The students taught by concept attainment were least affected. Similarly, in case of 7th class, inquiry training model was the
most effective, and then comes concept attainment model and the least effective was traditional model. In case of class 8th the concept attainment model has affected the student most. The inquiry training model of teaching has its place in increasing the environment awareness and the traditional model comes at the last place. Thus we can say that the three models of teaching have affected the students’ significantly regarding environmental awareness. The inquiry training model has affected the students most. Then comes the concept attainment model and the traditional model comes the last in effectiveness.

Aarti Kalani (2008) conducted a study on the effectiveness of Concept Attainment model over conventional teaching method for teaching science in relation to achievement and retention.

Objectives of the study were:

1. To study the effect of teaching model on attainment of concept at high school level.

2. To study the relative effectiveness of concept attainment model and conventional method of teaching at high school level.

3. To study the effect of teaching model on achievement at high school.

4. To study the effect of teaching model on retention of high school level.
Hypotheses of the study were:

1. Teaching through teaching model (concept attainment model) and conventional method affects academic achievement of high school level.

2. Teaching through concept attainment model and conventional model affect attainment of concept in high school level.

3. Teaching through concept attainment model affect retention in high school level.

Findings of the study were:

1. The achievement of students who were taught by concept attainment model was found to be better than conventional method.

2. Concept attainment model was more effective than conventional method with respect to the scores on attainment on the concept in science.

3. Concept attainment model was more effective than conventional method in the retention of concept.


Objectives of the study were:

1. To compare the mean pre-test scores and pre-test scores of Attitude towards Science of the experimental and control group.
2. To compare the mean pre-test scores and post-test scores of Process Skills in Science of the experimental and control group.

**Tools used for the study were:**

Lesson transcript for Process Approach Model of Teaching; Lesson transcript based on Constructivist Model of teaching; Achievement Test in Biology of std IX pupils; Classroom Environment Inventory; Socio-Economic Status Scale; Standard Progressive Matrices test by Raven; Test process Skills in science for the secondary school pupils; and Scale of Attitude towards Science.

From the findings,

It is evident that the Process Approach in Science is superior to the constructivist model of teaching for increasing Attitude towards Science and Process Skills in Science. The new approach helps the teacher to increase his /her knowledge about the outcome of teaching. In ordinary classroom teaching model, there may not been much emphasis on the development of process skills. The skill which are developed, really help students to nature a new world in their learning approach. They feel more close to nature in their learning approach. Teachers need to select curricula which emphasize science process skills. In addition they need to capitalize on opportunities in the activities normally done in the classroom.
Sood Vishal (2012) studied the “Effect of Mastery learning Strategies on concept attainment in Geometry”

Objectives of the study were

Compare the relative effectiveness of

i) Bloom’s LFM Strategy and the conventional method of teaching on concept attainment in geometry among high school students.

ii) Keller’s PSI and conventional method

iii) Bloom’s LFM strategy and Keller’s PSI on

A random sample of 105 students studying in 9th class was selected and the “Three-Groups – Randomized matched pre-test-post-test design” was employed.

Findings:

1. Students taught through Bloom’s Mastery learning strategy significantly higher from the students taught through conventional method of teaching with regard to concept attainment in Geometry

2. Keller’s PSI was found to be significantly more effective in the attainment of geometrical concepts in comparison to the conventional method of teaching.

i) Thus it was concluded that both Bloom’s LFM strategy and Keller’s PSI were significantly more effective to concept attainment in Geometry compared to conventional method of teaching.
ii) Bloom’s Mastery Learning Strategy was significantly more effective in teaching concept attainment in geometry compared to Keller’s personalized system in instruction.

2.2.1. Synthesis of studies related to concept attainment mode:


2.2.2 A Trend report on Models of Teaching:

In India, during the last few decades, efforts have been made to study the class room behaviour of teachers through Flander’s Interaction Analysis Category System which equips them to change their teaching behaviour so that development in the cognitive and affective domains of pupils can be brought in. Efforts were also made to identify teaching skills for teaching different subjects. Also the microteaching technique
was researched for improving upon general teaching competence: Later, different strategies of integration of teaching skills were tried out. Another group of researchers tried to find out the teaching patterns which are conducive for developing cognitive and affective behaviour. It is generally agreed that the objectives to be achieved through the teaching learning process are multidimensional in nature. It is also felt that a particular method or technique may not be appropriate for achieving the multi dimensional objectives. This led researchers to explore the use of various methods and techniques in an integrated fashion which resulted in the development of new instructional strategies. The greatest emphasis was on development of the cognitive domain. All these efforts did little for achieving the all-round development of the personality of the child. In other words, cognitive, affective and psychomotor behaviour must be developed in a balanced and integrated fashion. Models of Teaching have great potentiality for achieving this goal of education.

Joyce and Weil (1980) developed more than 20 models which were grouped on the basis of their chief emphasis the way they approached educational goals and means. They have classified models into four families. These are Information Processing Models; Social Interaction Models; Personal Models; and behaviour Modification Models. Information Processing Models share an orientation towards the –information-processing capability of students and ways they can
improve their ability to master information. Various models of this family are the Inductive Thinking Inquiry Model, Scientific Inquiry Model, Inquiry Training Model, Concept Attainment Model, Cognitive Growth Model and the Advance Organizer Model.

Social Interaction Models emphasize the relationships of the individual to society and to other persons. Among models falling under this category are the Group Investigation Model, Social Inquiry Model, Laboratory Method, Jurisprudential Inquiry Training Model, Role Playing Model, Value Discussion Model and the Social Simulation Model.

Personal models share an orientation towards the individual and the development of selfhood. Among models of this family are the Non-directive Teaching Model, Awareness Model, Synectics Model, Conceptual Systems Model and the Classroom Meeting Model.

Behaviour Modification Models were evolved from attempts to develop efficient systems for sequencing learning tasks and shaping behaviour by manipulating reinforcement. Exponents of reinforcement theory, such as Skinner (1957) have developed these models and operant conditioning as their central mechanism. Among the various models were the Programmed Instruction Model, Managing Behaviour Model, Relaxation Model, Anxiety Reduction Model, Assertive Training Model and the Simulation Model.
Related to Models of Teaching, this vital area of research, the first study at Ph.D. level, was completed in 1983 by Chitriv at Nagpur, while at M.Ed., level the first study was conducted in 1979 by Buddhisagar at Indore. By now a large number of studies have been completed. These relate to studies where in models of teaching have been used for teaching and for training of teacher educators and student-teachers in Models of Teaching. In short, the studies relate to the teaching and training aspects of Models of Teaching. Various models of teaching such as the Advance Organizer Model (Buddhisagar, 1979; Patania, 1980; Dennis, 1984; Malik, 1985; Rajoria, 1986; Panda, 1986; Senapati, 1986; Rajoria, 1987; Evelyn Fsearls, 1988; Agens Downing, 1995; Carol M Story, 1998; Harvinder Kaul, 2002; Tseng C.H, 2004; Heloiza Rbarbosa, 2005; Katherine, 2006; Dell Olio, 2007; Gangashree.G.v, 2008; Sunitha.M, 2008; Huifen lin, 2008; Fred N Keraro, 2009. The Inquiry Training Model (Katyal, 1985; Dubey, 1986; Kaur, 1998; Ahmet Kilinic, 2007), the Concept Attainment Model (Kumaria, 1985; Pani, 1985; Das, 1986; Behari 1986; Gangrade, 1986, 1987; Shamnad.N, 2005; Arati Kalani, 2008; Khan Zeenath Muzaffar, 2008), the Cognitive Growth Model (Senapaty, 1985); the Jurisprudential Inquiry Model (Tiwari, 1986); the Information Processing models (Sanjayan.T.S, 2009); the Multiple models (Allan G Harrison, 2003); the Synectics Model (Sheela. G, 2004); Comparative study between Concept
Attainment Model and Adavance Organizer Model (Rajinder Pal Kaul Sidhu, 1997; Parminder Singh, 2005; Raj Rani Agrawal, 2006; Shyamsundar Bairagya 2006); Comparative study between Concept Attainment and Inquiry Training Model (Vishwanath. H.N, 2002; SunitaBhalla Mehan, 2007), and the Non-Directive Model (Sahani, 1986) have been investigated where in teaching has been done with the help of Models of Teaching.

Related to Models of teaching, few Ph.D., studies were completed. These were by Chitriv (1983), Ghosh (1986); Pandey (1986), Buddhisagar (1987); Sushma (1987), Baveja (1988), Vishwanath (2002) and Sheela (2004). While comparing the Concept Attainment Model and Advance Organizer Model with traditional methods in terms of performance on the concept knowledge test Chitriv (1983) found that the Advance Organizer Model as well as the Concept Attainment Model were significantly superior to the traditional method, whereas the Advance Organizer Model was superior to the Concept Attainment Model for teaching mathematical concepts to XI grade students. Prose-passage type pictorial type advance organizers facilitated the retention of Life Science subject matter even after an interval of four weeks (Ghosh, 1986). Ghosh also observed that instructional strategy with pictorial type of advance organizer was found to be better than the prose-passage type of advance organizer. Pandey(1986) reported that both the Advance Organizer
Model and Inquiry Training Model were significantly superior to the traditional method in terms of pupil achievement, whereas all the three equally effective in terms of pupils’ attitude towards social studies. The Advance Organizer Model and Operant Conditioning Model were significantly superior to the traditional method in terms achievement of B.Ed., students in educational psychology (Buddhisagar, 1987). The concept Attainment Model and Biological Science Inquiry Model were found to be significantly superior to conventional teaching in terms of classs VIII pupils’ achievement (Sushma, 1987) The concept Attainment Model, Inductive Thinking Model were found to be superior to the traditional method in terms of concept attainment and retention (Baveia, 1988).

On the basis of studies presented in this category, it may be said that the conventional method of teaching different subjects at various levels was found to be less effective than various innovative teaching patterns like programmed instruction, instructional strategies and models of teaching in terms of achievement of students. In spite of this, it is difficult to determine which instructional strategy, pattern of teaching or model of teaching is most appropriate for teaching different subjects at various levels. This is due to the fact that no two studies are alike in all respects such as, design, sample, tools, treatment, dependent variable, etc. The researchers took achievement as a criterion variable. There is need
to deviate from this traditional approach to selecting a criterion variable. In the case of some studies, the criterion variable belongs to the affective domain. The psychomotor domain seems to be out of sight of researchers. In the case of Models of Teaching, Joyce and Weil (1980) have given instructional effect as well as nurturing effect for each model. Thus, studies may be designed in developing tools to measure these effects and thus facilitate study of the effectiveness of model of teaching in terms of instructional and nurturing effects.

2.3. Studies related to Achievement in Science:

Sharma V.S. (1975) Compare the achievement of Boys and girls in general science and mathematics at delta class in Rajasthan. The main objective of this study was to compare the achievement of pupils of delta class in general science and mathematics. The institutions selected for the administration of the tests comprised 24 each of the four types of institutions viz. rural, urban, boys and girls of the state of Rajasthan.

The study revealed the following, i) the prevalent syllabus in general science and mathematics for the students of the delta class in Rajasthan was highly effective, out moded and wanting in a proper process of evaluation. There was no proper relationship between the course content prescribed in the syllabus and that presented in the text book for the delta classes’ pupils. ii) The reliability of the test prepared by the investigator in general science ranged from 0.91 to 0.93 and that in
mathematics from 0.96 to 0.88. iii) The validity co-efficient of the test in general science ranged from 0.45 to 0.58 and that for the test in mathematics from 0.44 to 0.57. iv) The performance of the pupils in general science was highest in sirohi, sikar and Tonk districts and honest in district of Bikener, Udaipur and Bundi. In the present review studies related improvement of achievement and influence of different factors on achievement in science have been emphasized owing to the nature of investigation.


The objectives of the study were i) to compare the science achievement, science interest and mental health status of secondary school pupils in English medium and Malayalam medium classes. Ii) To determine the relationship between the medium of instruction and science achievement, science interest, mental health for the total sample and sub samples.

The study had a sample of 890 secondary school pupil students chosen by the application of stratified sample method.

The findings of the study were, i) Science achievement, science interest and mental health status of pupils’ of English medium classes were higher than those of pupils of Malayalam medium classes.
ii) Science achievement, science interest and mental health status of pupils of English medium classes were higher than those pupils of Malayalam medium classes for sub-samples equated on the basis of intelligence, interest and mental health status. iii) For sub samples equated on the basis of high socio-economic status and high mental status, the differences between English and Malayalam medium classes in science achievement and science interest were not significant.


The objectives of the study were, i) To investigate the relationship between achievement of pupils of high and low SES and pupils’ attention behaviour, pupils’ response behaviour, pupils’ seat work behaviour, pupils’ soliciting teacher behaviour, pupils involvement in classroom managerial activity, pupil’s out of school achievement related (POSAR) study time, POSAR library study, home time, curricular study time, non-curricular, study time, teacher explaining, questioning, helping, supervising, managerial behaviour. ii) To study the prediction of achievement of high and low SES pupils by their classroom behaviour, their achievement related efforts and their behaviour.

The multistage sampling procedure was adopted in the study. The sample comprised of 80 pupils. The findings were, 1) Listening
attentively had a positive correlation with achievement in science practicals in the case of high SES pupils, while in case of low SES pupils it was positively related with achievement in theory. 2) Correlation between pupils’ looking fatigued and achievement in science practical’s as well as total achievement were negative in case of low SES pupils in the beginning of the session. High SES pupils showed negative correlation with achievement in practical’s at the end of the session.

Chikkar, M.S., (1985) investigated the relationship of reasoning abilities with achievement of concepts in life science. The objectives of the study were 1) it is feasible to identify the hierarchy of concepts in life science in to seven levels of organization of Biological phenomena and to measure achievement of these concepts through objective tests. 2) It is possible to predict conceptual achievement in life sciences on the basis of reasoning ability tests.

The tools used in the study were battery of concepts achievement tests and battery of reasoning ability tests developed by Girish Bala. The subject content of classes VI to X was analyzed and 274 concepts were found out. Nearly 200 students selected from four government boys senior secondary schools of south Delhi constituted sample.

The findings of the study were 1) a slight modification was made in the hierarchy levels of organization of biological phenomena
when concepts in secondary school life sciences were identified and concept achievement test was found reliable and valid. 2) A definite positive relationship between conceptual achievement in life sciences and reasoning ability was found.

Ghosh, G.P., (1985) Studied the Achievement of the students in chemistry and finding relationship with some of its determinants. The main purposes of study were, i) to appraise the achievement of the students in physical science. ii) To appraise the extent of academic motivation, intelligence, and socio-economic status of the students. iii) To find out sex wise and strata wise differences, if any in the achievement in physical science. iv) To determine relationship among the scores of the achievement tests in physical science, the intelligence test, the academic motivation test and Socio economic status scale. v) To develop regression equation of the achievement in science on intelligence academic motivation and socio-economic status.

An achievement test in chemistry was standardized on 450 boys and girls (Just promoted to class X) reading in nine schools in west Bengal. Some of the major conclusions were 1) Urban students did not show better performance in the achievement test in chemistry. (ATC) than rural students. 2) Boys did not show superiority in ATC over girls. 3) There was a positive correlation between the scores in ATC and academic motivation test, ATC and group intelligence test, urban and
rural students’ scores in ATC and education of the parents as well as occupation of the parents. 4) Scores in ATC could be predicted from the scores in academic motivation Test, Group intelligence test and SES of the parents through multiple regression equation .5) The ATC was reliable and valid. Norms were also satisfactory.

**Mehna.V.H (1986)** Investigated in to some factors affecting academic achievement in science of standard IX students of greater Bombay. The major objectives of the studies were i) To find out the predictors of achievement in science as a whole, physics, chemistry and Biology. ii) To study sex differences in case of predictors of achievement in science as a whole, physics, chemistry and Biology.

Motivation for learning science and achievement tests in physics, Chemistry and Biology constructed by the researcher. The sample comprised of 308 girls and 376 boys of class IX of English medium schools of Greater Bombay selected through the cluster sampling method. The major findings of the study were, 1) Six variables viz. verbal intelligence, motivation for learning general science, Scientific knowledge and aptitude, numerical ability, liking for teachers of science and interest in medicine were significant predictors of achievement of class IX students in general science (R=0.5773). The significant predictor variables for boys were scientific knowledge and aptitude. Motivation for general science, verbal intelligence, interest in commerce,
numerical ability and liking for science teachers (R=0.5463). The significant predictors of achievement in general science for girls were verbal intelligence, Motivation for general science, Scientific knowledge and aptitude, liking for teachers of general science and numerical ability (R=0.6500). 2) The significant predictor variables for achievement in physics for students of class IX were the same as those found in the case of general science with the addition of one more variable abstract reasoning. The significant predictors of achievement in physics in the case of boys were scientific knowledge and aptitude, motivation for learning physics, verbal intelligence interest in commerce, motivation for learning general science (other than physics) and numerical ability (R=0.5798) in case of girls the predictor for physics achievement were scientific knowledge and aptitude, motivation for learning general science other than physics, verbal intelligence, numerical ability and liking for physics teachers (R=0.6184). 3) The significant predictors of achievement in Chemistry of students of class IX were verbal intelligence, motivation for learning Chemistry, scientific knowledge and aptitude, numerical ability, interest in the arts (R=0.5573). In the case of boys, all the above variables with the exception of the interest in medicine were found to significant predictors of achievement in Chemistry (R=0.5283). In the case of girls, the predictor variables were the same with the exception of numerical ability and interest in fine arts (R=0.6026). 4) Six significant
predictors of achievement in Biology in the case of students of class IX were verbal intelligence, liking for Biology teachers, motivation for general science subjects other than Biology scientific knowledge and aptitude, interest in medicine, interest in commerce (R=0.4938). Significant predictors of achievement in the case of boys were verbal intelligence, motivation for learning Biology, liking for Biology teachers and interest in commerce (R=0.41f91). In the case of girls the predictor set included verbal intelligence, liking for Biology teachers, motivation for general science subjects other than Biology, scientific knowledge and aptitude and interest in medicine(R=0.6066). 5) Abstract reasoning was found to be a significant predictor only for physics achievement. Numerical ability was a significant predictor of achievement in physics and Chemistry but not Biology.

The research findings imply that the pupils’ performance in science subjects can be improved 1) of teachers succeed in generating a feeling of liking for than among pupils. 2) Of teachers develop aptitude for science among children by providing scientific information. 3) Of teachers can motivate children to learn science subjects. This needs adequate training for teachers in making science teaching interesting and in training them in the techniques of arousing pupils’ motivation for learning science.
Panda (1986) determined “The effectiveness of Advance Organizer and traditional method of teaching on the achievement of 9th grade pupils”.

His findings were
The difference between the mean achievement of pupils studying through AOM, set induction and traditional method were effective.

Senapathi (1986) Studied, “Comparative study of Programmed learning material, Advance Organizer Model and Traditional method in terms of achievement of students studying through them and effect of personality factors on achievement”.

He found out that the Advance Organizer Model was effective than both programmed learning material and traditional method in terms of achievement of students on criterion test.

Singh.S.(1988) investigated in to the relationship between achievement of certain concept of physical chemistry and cognition and convergent production of semantic classes. Relations and implications of the morphological model of structure of intellect. The major objectives of the study were, i) to identify through analysis of content. Conceptual hierarchies of concepts of atomic structure, periodic properties of elements and chemical bonds and molecules, according to sequential learning model of Gagne. ii) To construct an achievement test in order to assess achievement in concepts of physical chemistry selected for study.
iii) To study the relationship between concept achievement composite and reasoning ability composite, concept achievement composite and convergent production of semantic classes relations and implication.

iv) To identify the factors that would explain the common variance in various sub tests of concept achievement in physical chemistry. The sample of the study consisted of 200 students of class XI. The major findings of the study were, i) a significant positive relationship was found between reasoning ability and achievement of concepts in physical chemistry. ii) a significant positive relationship between concept achievement composite and reasoning abilities represented by six SOI categories. iii) In the correlations between 19 reasoning ability tests and composite of concept achievement in physical chemistry except for apparatus test (CMI) word grouping and figure concepts (NMC), all the other correlations were significant at 0.5 levels.

2.3.1 Synthesis of studies related to Achievement in science:

Comparison in achievement in science among boys and girls (Sharma, V.S. 1975), Impact of medium of instruction on science achievement (Raveendranathan 1983), different socio-economic state and achievement in science (Yadav, 1984), reasoning abilities and achievement in science (Chikkar 1985,), achievement in Chemistry with some of its determinants (Ghosh, 1985), Factors affecting academic
achievement in science concepts with that of cognition, convergent production of semantic classes (Singh, 1988),

2.4. Studies related to Attitude towards science:

Sood (1974) studied the attitude towards science scientists among the students and teachers and found that the understanding of science positively related to it.

Sarah, Shanta Kumari, Williams A. (1983) have studied Attitude of high school pupils towards general science and its relationship with achievement in a stratified proportionate sample of 3000 that formed 26.64% of the total population. The major findings of the study were – 1) the attitude of the high school pupils towards science and science education in Tamilnadu was generally favorable but there was wide disparity in their attitude. 2) When their attitude towards science and attitude towards science education were partial led out, the coefficient of correlation between their achievement and SES was found 0.1164 and it was significant at 0.01 levels. 3) When the effects of the pupils’ attitude towards science as well as their SES were partial led out, the coefficient of correlation between the attitude towards science education and achievement was found to 0.4062 and it was found to be significant at 0.01 levels. 4) When the effect of attitude towards science education and their SES were partial led out, the coefficient of correlation between their attitude towards science and their achievement was found to be 0.07661
and it was not significant. 5) It was found that about 30% of the variance in science achievement was accounted for by one's attitude towards science, one's attitude towards science education and SES.

**Bandhopadhyay J.** (1984) studied Attitude towards science and related factors in a sample of 420 adolescents (221 boys and 199 girls from 21 schools of Calcutta. The data were represented by charts and tables and analyzed by statistical tools like t-test, ANOVA and Chi – square test. He found that parents’ education and SES led to favorable attitude towards science besides other contributory factors like teacher’s influence, peers, influence, vocational value of education and the future aim in life. The pupils who had a favorable attitude towards science possessed higher ability in mechanical comprehension and visualization of objects in space. They were higher achievers (a) Source of inspiration and achievement in Physical science, (b) Source, Achievement in Physical science and Space relations and (c) Source, Achievement in Life sciences and Space relations.

**Goalwalkar S.** (1986) studied scientific attitude, creativity and achievement of tribal students of Rajasthan. The objectives of the study were: 1) to study the scientific attitude of tribal students studying science in secondary school located in tribal areas. 2) To compare this with the scientific attitude of non-tribal students of the same schools studying science in secondary classes. 3) To compare the creativity of tribal’s with
the non-tribal, 4) To compare the achievement of tribal and non-tribal students in science subjects. The sample consisted of 270 tribal students and 270 non-tribal students of classes IX and X offering science as an optional subject. The tools and techniques used were the scientific attitude scale, thinking creativity with words, and thinking Creativity with figures. The major findings of the study revealed that – 1) Non-tribal students were superior to tribal students on three components and no significant difference in seven components of scientific attitude. 2) There was no significant difference between the mean scores of the tribal and non-tribal’s in seven components. On no factor did the tribal fare better than the non-tribal. The overall mean scores on the scientific attitude scale for non-tribal were higher than for tribal. 3) There was a significant difference between the mean creativity scores of the tribal and non-tribal. The non-tribal had higher levels of creativity than the tribal students. Factor wise comparison of the two groups on the basis of verbal test creativity showed that for the fluency component, the mean fluency scores of non-tribal were higher than that of the tribal. The two groups did not differ significantly on flexibility component. The mean originality score of non-tribal was higher than that of the tribal. 4) The non-tribal had a higher scholastic achievement in science subjects than the tribal students.
Chery L. Mason, Jane Butler Kahle (1988) have designed a project to foster the full and fair participation of girls in high school science classes. Addressed obstacles, both perceived and actual, to equal participation. In order to modify existing classroom techniques and environments, a teacher intervention program was designed. By personal communications, teachers were sensitized to the importance of a stimulating gender-free learning environment. In addition, they were presented with a variety of methods and materials, which had been shown to encourage girls in science. Twelve teachers who were selected randomly, taught in diverse communities throughout one Midwestern state. The subjects tested were students in 24 general Biology classes taught by the 12 teachers. Using ANOVA treatment group by students’ sex, a comparison of the mean score was made for all students, as well as for all females and all males. The results indicated that the experimental group, compared to the control group, had significantly higher mean scores on tests of attitude towards science, Perceptions of science, extra-curricular science activities and interest in science related careers.

Mandila, Shyam Singh (1988) focused his study on assessing the attitudes of secondary students towards science curriculum and its relationship with achievement motivation on a sample of 500 students through survey method. The objectives of the study were, 1) To determine the Attitude of Science students about science curriculum, 2)
To compare the differences between Urban and Rural, Intelligent and weak, male and female students about the Attitude towards Science curricula and 3) To determine the extent and direction of relationship between Attitude and Achievement. The tools employed are Attitude Scale developed by the researcher and Achievement Motivation by Prayag Mehtha. The obtained data was analyzed both qualitatively and quantitatively. The major findings of study are 1) students from rural school and urban schools as well as male and female had favorable attitude towards science curriculum. 2) There were significant differences in some aspects such as Science Temper, and teaching methods. 3) Students from urban schools scored higher on achievement motivation tests. 4) Most of the weak students scored less on achievement motivation test. 5) Female students scored higher than their male counterparts. 6) Enriched academic programs helped in developing favorable attitudes.

Kar D.K.(1990) examined the problem of relationship between attitude and achievement in general science of 700 class IX students form 10 high schools of Cuttack city, also included are 74 science teachers, science experts, professors, educationists and head masters of the sample schools. The objectives of the study were, 1) to assess the relationship between the Attitude and Achievement in general science of class. The sample selection was through random stratified sampling method. The
tools used to collect data were Questionnaire, Interview schedule, Achievement tests in science and Attitude towards science scale. Data analysis procedures included measures of central tendency, variance and correlation coefficient. The major findings of the study are 1) the distribution of the attitude score was negatively skewed. 2) Boys are found to be more favorably disposed towards science than girls 3) there was positive relationship between attitude towards science and achievement in science.

Rao, Digumarthi Bhaskara (1990) in an attempt to compare scientific aptitude and achievement in Biology at the secondary school level took a sample of 600 IX standard students through a stratified sampling procedure. The tools used in the study included Science Attitude Scale of J.K. Sood and R.P. Sandhya, and Kerala University Science Aptitude test of Nair et al. Major findings of the study are 1) the science attitude in secondary school pupils was average. There was no significance of sex on science attitude. But the pupils studying in Private schools, Residential schools, English medium schools and rural schools held relatively better science attitude than their counterparts. 2) The Science Aptitude in secondary school pupils was also average. The pupils of Private schools, urban schools, English medium schools and Residential schools held relatively better science aptitude. 3) The achievement in Biology was also average. The Rural schools,
Government schools, English medium schools and Residential schools were better in achievement. 4) There was a highly significant and positive association among attitude, science aptitude and achievement in Biology.

**Sharma, Munishwar Kumar** (1990) investigated the incidence of science literacy, Attitude towards science and the personality traits of certain groups of students and teachers. The objectives of the study were 1) To study the level of scientific literacy of different groups of students and teachers; 2) To study the Attitude towards science of different groups of students and teachers; 3) To study the Personality traits of different groups of students and teachers. The tools used are science Literacy scale and Attitude towards science and Cattle’s 16 PF Questionnaire. The obtained data was analyzed through ANOVA. The findings of the study revealed that 1) the total sample had high level of science literacy than the theoretical mean. 2) There was significant difference between the general group and the scheduled caste and scheduled tribe groups. 3) The total sample had favorable attitude towards science. 4) There was effect of type of school and sex on attitude towards science. 5) There was no significant difference between the students and teachers on personality factors.

**Dale R. Baker and Michael Piburn** (1991) have investigated the effects of Scientific Literacy Course (SLC) on the skills, Cognitive
Ability and Attitude towards Science in the first years of High School. The researcher examined 1) whether incoming student characteristics affect the development of Attitude and cognitive ability. 250 students (126 males and 124 females) ninth grade students were enrolled in specially designed Scientific Literacy Course, which met for 3 hours and 20 minutes each week for 39 weeks. Students were pre-tested for Logical, Spatial, and Verbal and Mathematical ability as well as for Attitude towards science and Self- concept and Psychological type. The course was successful in teaching skills. Measurement skills and Academic self-concept. Attitude declined due to participation in the course. Self – concept and Mastery were related to Cognitive variables and Motivation, Mastery and Control were related to Psychological type.

Malviya, Dharma Shila (1991) studied the attitude towards science and interest in science among 820 school going class IX adolescents and 193 teachers of Madhya Pradesh. The tools used are Attitude scale (Likert Method of summated rating scale 5 point) and Interest inventory by Raghuraj pal Singh. The major findings of the study are 1) A positive attitude towards science was observed among all the six groups of students (Boys - girls; Tribal girl student primary school and educational school; Rural students – urban students and high – SES Low SES of students. 2) Significant difference between the means of rural school and urban school – boys and girls revealed that sex had no effect
on the attitude towards science differed in respect of sex in early ages. 3) No significant difference between male and female teachers attitude towards science revealed that sex had no effect on the attitude towards science in the later years. 4) Significant difference between the means of rural school and urban school – boys and girls revealed that the attitude towards science differed in respect of area. 5) No significant difference between male and female teachers attitude towards science revealed that sex had no effect on the attitude towards science. 6) No significant difference between experienced and new teachers’ that an increase in age had no effect on the attitude towards science. 7) Significant difference between the mean scores of boys and girls on different factors of attitude towards science and significant in mean scores of students and teachers on different components of attitude towards science revealed that age, sex, profession and socio-economic status had no effect on attitude towards science. 8) Coefficient correlation between the different factors of attitude towards science showed moderate correlation between with each other. 9) Coefficient correlation between the different factors of Interest showed moderate correlation with each other. The correlation of scientific factor was comparatively higher than other factors. 10) The mean scores and standard deviation of the science interest factor was higher than the interest factors. This showed that the students who had got high positive attitude towards science could also have high interest in
Attitude and different factors in scientific interest i.e. Mechanics, Business, Scientific, Aesthetic were significantly correlated. Attitude and clerical factor of interest was also significantly correlated. Other two factors of interest namely Social and Outdoor factors did not show any significant relationship with attitude. 12) Obtained value of “F” on the basis of one way ANOVA showed significant difference between the different groups of students in attitude towards science. 13) The value of “r” in case of science factor was higher than other factors. It clearly showed that the students who had positive attitude towards science also had greater interest in science. 14) A “t” test analysis of Attitude towards science showed significant positive gain in Attitude towards science for the entire groups of students.

**Gabriel Adeniji Ajewole** (1991) has investigated the effects of Discovery and Expository Instructional Methods on the Attitudes of students in Biology. The sample consisted of 240 students from IV Biology students randomly drawn from six selected Secondary schools in the Oyo state of Nigeria. They were assigned into two groups – Experimental and control. The experimental group was exposed to Discover Instructional Method and the Control group to the Expository Instructional Method. The science class of Form IV in each of the six schools was selected intact for the study. The major instrument was the 40-item Scientific Attitude Questionnaire (SAQ). It is a Likert type
questionnaire using five scales. Two hypotheses were tested. Results showed that the Experimental groups evinced a significantly more favorable attitude towards Biology than the Control group. It was also found that the high-, average – and low ability groups in the Experimental class evinced a more favorable attitude towards Biology than their counterparts in Control class. However, there was no significant difference in the attitudes of male and female students exposed to the Discovery Instructional Method or Expository Instructional Method. It is recommended that Science Learning using the Discovery Method may enable the learner to evince more a favorable attitude towards problems recognition and problem-solving than when learning by Expository Method.

Luanne Gogolin (1992) has investigated the attitude towards science of non-science college students (NSCS) using quantitative and qualitative forms of inquiry. Quantitative methods were used to determine – a) how attitude towards science of NSCS compare with attitude of science majors and b) whether attitude towards science change with instruction. Qualitative assessment was used to investigate attitude development as it relates to science. The subjects were 102 NSCS and 81 science students. Six attitudinal variables were investigated using the attitude towards science Inventory as the Quantitative instrument. Hotel ling’s T2 showed a significant difference \((p= 0.0001)\) in attitudes
between the two groups. T tests revealed significant difference between
the two groups for all six variables. A significant difference (p=0.001)
was found between pre and post-test results for the NSCS. T-tests showed
significant difference between the two sets of scores for all six variables,
indicating a favorable change in attitudes. An interview questionnaire
was used to investigate factors contributing to attitude, suggested that
attitudes towards science are formed by interactions of both school and
non-school variables.

Srivastava, veena (1992) investigated creativity in relation to
Scientific Aptitude and Attitude towards Science on a large sample of
600 boys and 600 girls from higher secondary schools of Agra city. The
tools used were Creativity Test by Chauhan and Tiwari, Scientific
Aptitude battery by K.K. Agarwal, Sammohik Manasik Yogyata Pariksha
by R.K.Tandon and the Attitude towards Science by Avinash Grewal.
Findings of the study revealed that 1) the science students of higher
secondary classes having more scientific Aptitude were more creative
than those having less scientific aptitude. 2) In the field of creativity, the
boys having favorable attitude towards science were slightly better than
those having unfavorable attitude towards science where as the girls with
favorable and unfavorable attitude towards science did not differ. 3) The
girls were more creative than the boys.
4) The boys had more scientific aptitude than the girls. 5) The girls had more favorable attitude towards science than the boys.

**J. O’Brien and G.C. Porter** (1994) have reviewed the situation in Ireland in relation to the number of girls studying physics and chemistry. A scheme of intervention projects to reduce the under-representation of girls in the physical science is described. The measured attitudes of students based on a Likert type scale are reported. The effects of number of factors on those attitudes were investigated. Students in Project schools were shown to have similar attitudes to physics than those in the Control school indicating the success of the intervention in establishing the teaching of physics and in increasing the number of girls who study the subject. Students in the project schools have positive attitude in relation to girls’ ability in physics, while boys have more positive attitude to everyday application of physics. Students in the Co-education schools tend to have more negative attitudes and the larger the school the more negative the attitudes of the students. The effect of changing involvement of the visiting teacher is reported and in relation to girls’ ability, attitudes generally become less positive the longer a school is within the scheme.

**Marshall D. Sundberg and Michael L. Dini Elizabeth Li** (1994) in their study demonstrated a small but significant difference in prior understanding of basic Biological concepts between students
enrolled in majors’ versus non-majors’ introductory Biology courses. By the end of their respective courses, non-majors demonstrated greater improvement in post-test scores than did majors. Furthermore, although initially students in the major course had significantly more positive attitude towards science, especially in terms of personal comfort with science, by the end of the course this difference disappears. Following a semester of instruction, the attitudes of non-majors generally improved, but students’ attitudes in the majors’ classes declined in nearly all categories. The results further suggested that some instructors have a consistently strong impact on their students’ attitudinal change. It is concluded that there was a strong association between improving student attitudes and student performance on subject content.

Paul J. Germann (1994) used path analysis techniques to test a hypothesized structural model of direct and indirect causal effects of student variables on science process skill. The model was twice tested using data collected at the beginning and end of the school year from Ninth and Tenth grade Biology students who lived in a rural Franco-American Community in New England. Each student’s variable was found to have significant effects, accounting for approximately 80% of the variance in Science processing skills achievement. Academic ability, Biology knowledge and Language preference had significant direct effects. There were significant mediated effects by Cognitive
Development, parent Education and Attitude towards science in school. The variables of cognitive Development and Academic ability had the greatest total effects on science process skills.

**Mary Ann Evans, Myrna Whigham and Morgan** (1995) in their in school intervention project used female role models to change the attitudes of 964 Iowa girls and boys in 57 ninth grade science classes towards science, mathematics and technical curricula and careers. The differences between the students mean pre-test and post-test scores on each of six factors found to be associated with students’ attitude towards science and mathematics and technical careers were analyzed to determine which of five experimental groups responded most positively to the intervention. Higher difference scores indicated that the attitudes of girls and boys who participated in the intervention improved more than the attitudes of girls and boys in the control groups, suggesting that the use of female role models in the science classroom is an effective way to change students’ attitude towards science, maths and related career.

**Padhi J.S. (1994)** has attempted to find out I) The nature of relationship existing between the high school students perceived science classroom environment (SCE) and their attitude towards science, II) There was significant effect of gender and classroom environment on their attitude towards science and III) Classroom environment dimensions that affect attitude towards science different types of schools. The sample
comprised 200 students of class IX of different types of high schools of Orissa i.e. Navodaya Vidyalaya, Kendriya Vidyalaya, Government schools and private schools in Urban and Rural areas. The tools employed were Individualized classroom environment Questionnaire by Fraser and science Attitude Scale by Grewal (1997). Findings of the study were – I) Significant relationship was found between Classroom Environment Score and Attitude towards Science scores of High school students. II) Personalization and participation dimensions influenced students Attitude towards Science and III) Boys and girls differed significantly with respect to their Attitude towards Science.

Molly Weinburgh (1995) in his Meta analysis covering the literature between 1970 and 1991 examined gender differences in students’ attitude towards science and correlations between attitude towards science and achievement in science. 31 effects sizes and 7 correlates representing the testing of 6,753 subjects were found in 18 studies. The mean of the un-weighed effect size was 0.20 (SD=0.50) and the mean of the weighed effect size was 0.16 (SD = 0.50) indicating that boys have more positive towards science than girls. The mean correlation between attitude and achievement was 0.50 for boys and 0.55 for girls, suggesting that the correlation is comparable. Results of the analysis of gender differences in attitude as a function of science type indicates that for Biology and Physics the correlation is positive for both, but stronger
for girls than for boys. Gender differences and correlations between attitude and achievement by gender as a function of the selectivity of the sample indicate that general level students reflect a greater positive attitude for boys, where as the high-performance students indicate a greater positive attitude for girls. The correlation between attitude and achievement as function of selectivity indicates that in all cases a positive attitude results in higher achievement. This is particularly true for low – performance girls. The implications of the study were to continue research that examines strategies in the classroom for improving students attitude towards science especially those of girls, to continue research that examines Attitudes, gender and grade level and the last implication is that the greater differences needs to be examines by race in order to determine differences in girls of different ethnic backgrounds.

Lynne E. Houtz (1995) in his sequential methodological elaboration study investigated differences between middle school and the junior high instructional strategies and the effects on adolescent attitude towards science in school and science achievement. Subjects of the quantitative phase were 570 seventh and eighth grade students in one school in Urban School district in the Mid-West USA during a transition year from junior high to Middle school. German’s attitude towards science in school Assessment and the School District’s Bench Mark Exam were employed to measure students’ pre and post-test attitude and
achievement. Variations within grade level, gender, race, general ability and SES were evaluated. Results of split plots revealed no significant difference in attitude towards science between the Experimental Middle school group and the Junior High Control group at this phase. However there was significant improvement in attitude in both seventh grade population, but no change in attitude in either Eighth grade population. No significant differences in Attitude were found between males and females and Caucasian students and Students of color. The conclusions arrived from this study was that- 1) in the first year of transition the junior high instruction all strategy to the Middle school instructional strategy, it may be difficult to achieve significant differences in Attitude towards science and Achievement. 2) Traditional methods of assessment of learning objectives may not be appropriate for the approaches advocated by the middle school philosophy. 3) It also recommended that teachers involved in implementing new instructional strategies can be expected to have a wide variety of concerns, which will affect the success of the implementation process, they need a milieu of personal support as well as orientation information about the change.

Mary M. Atwaterl and John Wiggins (1995) in their research project have gathered demographic data, intentions to engage in science, and attitudes of Urban, Middle school students. Scores on the Simpson – Troost Attitude Instrument were analyzed using the Statistics Analysis
system. Results indicate less than 50% of the students show any interest to engage in science at the high school level. Yet many plan to enter a science related career. Less than 50% of the students come from high school graduated parents who work full time to support their family. A majority of the students possessed uncertain attitude towards their science teachers and science curricula. However, all possessed high achievement motivations, strong positive attitude towards their families and high self-concept.

Maitra, Krishna and Alka (1997) through their study “To explore the Attitude towards laboratories and other related practical work in science” have attempted (a) to explore the notion of science as perceived by students, teachers and other professionals towards teaching of science, (b) attitude towards practical aspects of science teaching, (c) specific attitudes towards teaching science, (d) to evaluate the effect of attitudes of students and teachers on the student’s performance in science and (e) the system of evaluation of science in schools. The sample comprised of 296 students of IX and X, 20 teachers teaching the classes IX and X and 5 other professionals. The data were collected through an attitude scale and interest inventory for students, questionnaire for teachers and semi-structural interview for other professionals, all developed by the researchers. Mean, SD, t-test and content analysis were used for data analysis. Findings of the study revealed that – 1) Rural girls
of class X had very high and positive attitude towards science, 2) Boys had more positive attitude towards science as compared to the girls towards the science practical where as girls emphasized the knowledge aspect more, 3) Students of class IX and X had similar attitude, 4) Boys who showed a more positive attitude towards science as compared to the girls were unable to reflect the same in their performances, 5) Science being a dynamic discipline needs constant updating of one’s knowledge, which was lacking in most of the teachers, 6) The maximum number of teachers failed to show their innovativeness in procedure for evaluating their students, 7) Though all the teachers were familiar with the doctrine of “Learning by doing” but failed to implement this in their own pedagogy, 8) The professionals asserted that teaching of science must include both processes and products and the curriculum should necessarily include numerous practical, 9) Professionals expressed that evaluation process for practical in class X should be through the external examination, and 10) It was found that the teachers’ attitude also influence attitudes of students and their performances.

2.4.1 Synthesis Of Review On Studies Related To Attitude Towards Science:

Development of favorable attitude towards science in students is found positively effective by the Understanding of science (Sood, 1974), Achievement in science (Sarah, Shanta Kumari, Williams, A. 1983;
Molly Weinburgh, 1995; Lynne E. Houtz, 199; Kar, D.K.,1990), Mechanical Abilities, Teachers influence and Future aim of Life (Bandhopadya,J. 1984; Malviya, Dharma Shila,1991), perceptions of Science, extra Curricular activities and Interests in Science related Careers (Cheryl L. Mason, Jane Butler kahle, 1988; Malviya, Dharma Shila, 1991), Method of Instruction among science majors (Luanne Gogolin, 1992), Performance in Science subjects by Non-Majors (Marshall D. Sundberg and Michael L. Dini Elizabeth Li, 1994), Science process skills (Paul J. Germann, 1994), Female role models on girl students (Mary Ann Evans, Myrna Whigham and Morghan, 1995), Classroom environment (Padhi, J.S.1994), Science Curriculum and Achievement Motivation ( Mandila, Shyam Singh, 1988), Science Aptitude (Srivastava, Veena, 1992) and achievement (Rao, Digumarthi Bhaskar, 1990), Scientific Literacy and Personality factors (Sharma, Munishwar Kumar, 1990) and Teachers’ attitude towards science (Maitra Krishna and Alka, 1997). It is also found that when the students were taught in Discovery Method of Learning (Gabriel Adeniji Ajewole, 1991) developed favorable attitude and also the girl students in project Schools (J. O’ Brien and G.C. Porter, 1994). Further certain studies have interestingly found that attitude towards science declined when the high school students were enrolled in a Scientific literacy Course (Dale R. Baker and Michael Piburn, 1991), in Co-education school students and
Larger School-Students’ (J. O’ Brien and G.c. Porterl, 1994), and Uncertain attitude towards teachers and Science Curricula (Mary M. Atwater and John Wiggins, 1995) was processed by Urban students and Non Tribals’ and Tribals’ did not differ in their Scientific Attitude (Golwalkar, S. 1986).

2.5. Studies related to retention:

Joyce and Weil (1985) established that inductive process of concept Formation and attainment increase students' retention of information by enabling them to develop mental structures which allow them to 'hold' the information better than structures which are provided for them. In addition, the inductive approach to concept attainment can help students’ in developing observational and analytical abilities.

Roskopt (1985) made a study on strategies for concept attainment in mathematics. He found that human beings tend to deal with classes of things instead of individuals in order to make same sense out of the environment. By forming such classes cognitive strain is reduced as well as the burden of memory.

Bhaveja (1989) found that concept attainment model is more effective than traditional method in learning; and retention of Biology concepts.

The study of Jamini.N. Which aimed to investigate the relative effectiveness of AOM and CAM on conceptual learning efficacy and
retention of chemistry concepts in relation to divergent thinking indicated that although both AOM and CAM were equally effective in fostering concept learning. The AOM was comparatively more beneficial in concept learning to pupils with high divergent thinking. While CAM was more beneficial to pupils with low divergent thinking. The AOM was found to be more effective than CAM in the retention of concepts irrespective of the level of divergent thinking of the pupils. Studies carried out by Mohammed (1991), Akinyemi (1992), Ajaja (2006), and Ojeifo (2000) revealed that the use of advanced organizers by students had facilitating effects on the students learning and retention of the concepts they were taught. Mohammed (1991) found out that the students in different classes performed better with the use of organizers in addition to the lessons.

However other researchers (Laoye, 1992; Salmon, 2000) in separate researches found out that the use of organizers did not have any facilitative effect on students achievement and retention of the concepts they were taught. These researches show that there are still conflicting results of findings in the use of organizers.

2.6. Conclusion:

A model of teaching as an area of research is emerging in a significant manner. Instructional effects and nurturant effects for each of the models of teaching have been hypothesized. The hypothesized effects
are improved concept building strategies, inductive reasoning, tolerance of ambiguity, sensitivity to logical reasoning in communication, scientific process skills, strategies for creative inquiry, spirit of creativity, autonomy in learning, and tolerance of ambiguity. The effectiveness of each model of teaching should be studied in the context of these variables. This activity will demand the development of new tools of measurement. Apart from this, the work sheets, the teaching analysis guides, and lesson plan formats have to be developed and their impact studied on the achievement of these objectives studied for which a given model of teaching has been designed.