CHAPTER 3.
REVIEW OF RELATED LITERATURE.

3.1 Introduction.

A number of research studies related to 'Information Processing Models of Teaching' and 'Science Teaching' were reviewed with the following objectives.

1. To find out whether there has been any study on the same problem.
2. To get an idea of how similar problems have been handled by other research scholars.
3. To get a direction for the collection and analysis of data.

The reviewed literature has been presented here in brief under the following titles:

- Studies related to Information Processing Models.
- Studies related to Objectives of Science Teaching.

3.2 Studies related to Information Processing Models.

1. "The effect of Advance Organizer on Science learning achievement of eighth grade Thai Demonstration School Students with average academic ability". (Tamthai, Pusadee, Piyakul; 1982)

Objective of the study: To determine the facilitating effects of a pictorial diagrammatic advance organizer on science learning achievement.

Sample and methodology: 188 students of class VII having average academic ability were selected from three schools. [One expt. group X one control group. Period of treatment – 4 weeks]

Field dependent – independent cognitive style was measured by the Group Embedded Figures Test (GEFT). Students with scores in the upper third and lower third of the score distribution of the group were classified as field independent and field dependent respectively.

Three-way analysis of covariance; one tailed t-test and two-tailed t-test were employed to test the hypothesis.
Findings of the study are:

- Advance organizer Model had no facilitating effect on male students. It had facilitating effect on female field independent and inhibiting effect on female field dependents.
- There exists a relationship between field dependent-independent cognitive style and science learning achievement. Independents scored higher than the dependents.

2. “The effects of Advance Organizers of varying length on the comprehension and retention of seventh grade students”. [Borine Ruberia Carol, 1982]

Objectives: To determine the effects of varying lengths of advance organizers on the comprehension and retention of seventh grade students. (The students were classified as at level readers if they scored 34th to 66th percentile and above level if they scored 68th to 88th percentile ranged on the reading comprehension subtest of the standardized achievement test. The dependent variables were the students’ scores on the comprehension and delayed retention test).

Sample and methodology: The subjects were randomly assigned to one of the three treatment conditions: 200 word advance organizers, 20 word organizers, and no organizers followed by a 1500 word expository passage. On the same day, they were also administered a comprehension test consisting of 20 items.

Findings:
- One immediate comprehension, the 20-word organizer ‘at level’ was superior to the 200 word and no advance organizer readers.
- For the ‘above level’ readers, there were no facilitative effects between the 200-word organizer, the 20-word organizer and no advance organizer readers on immediate comprehension.
- On delayed retention, the 20-word advance organizer ‘at level’ readers were superior to the 200 word and no advance organizer readers.
For the above record level readers on delayed retention, there were no facilitative effects among the 200-word, 20-word and no advance organizer readers.

The facilitating effects of the advance organizers, which have been established through a large number of research studies, seem to be absent for the above level readers on the criteria of immediate comprehension as well as delayed retention.

3. “The effectiveness of a Game Advance Organizer when used by concrete and formal operation students learning to solve Mendelian genetics problems”. (Mike, John G. Ph.D. Boston College, 1984)

The experimental group received a game advance organizer (The Yooki Mating game) and the control group was shown two filmstrips on genetic engineering. After playing the game or watching the filmstrips, the students complete programmed lessons on monohybrid and di-hybrid crosses.

The result of the study showed that the experimental group scored significantly higher on 'Genetic Problem Solving Test' than the control group in one school and no significant difference was found in the second school. Therefore, the efficiency of YMG as a game organizer cannot be determined with confidence.


This study investigates the effectiveness of advance organizers and repetition on Achievement at the High School level with respect to:

(a) Measurement of lower level cognitive skills, and
(b) Measurement of higher-level cognitive skills.

It was found that student performance in the control group was as productive as students’ performance in the experimental group.
5. "A Comparative Study of teaching science (Biology) as Inquiry versus Traditional didactic approach in Nigerian secondary schools". (Awadi, Shuaibu, Ed.D., Temple University, 1984)

This study is a comparison of achievement in Biology by Nigerian secondary school students (tenth graders) when taught either by the Inquiry or the Traditional (lecture) method. It was undertaken to address two major questions:

(a) What effect, if any, would Inquiry as a pedagogical method have on the Nigerian Science Students in terms of cognitive achievement in science?

(b) Could the level of pupil understanding of science and scientific processes be improved by teaching science as inquiry?

The results show that the students in the Inquiry group attained a significantly higher level of achievement than students in the traditional group. Based on these results, it is concluded that:

- Teaching science as inquiry significantly enhances Nigerian students achievement in science,
- The inquiry method is more effective method of teaching science than the traditional lecture method.


A framework test and a pre-requisite knowledge test were administered to fifty-nine students of class IX prior to the instruction. The students then received instructions on the nature of light and then a posttest on the unit.

It was found that advance organizer group performed significantly better than the pre-requisite knowledge group on the first framework test and the pre-requisite knowledge group performed significantly better than the advance organizer group on the pre-requisite knowledge test. The results of this study did not provide evidence that one pretreatment facilitated learning more than
the other. In addition, evidence to support Ausubel's hypothesis that Advance Organizers facilitate retention was not found.

7 "A study comparing the influence of Inquiry and Traditional science instruction methods on science achievement, attitude towards science, and integrated process skills in ninth grade students and the relationship between sex, race, past performance in science, intelligence and achievement". (Doty, Carlson, Ph.D., University of South Mississippi, 1985).

This study analyzed the effects of two methods of science instruction, Inquiry and Traditional, on science process skills, attitudes towards science and achievement in science with sex, race, past performance in science, intelligence and achievement.

Based on the findings of this study, the following conclusions were drawn:

- Subjects in the two groups did not differ significantly on science integrated process skills and attitude towards science.
- Subjects in the Inquiry group did differ significantly from those in the traditional group in science achievement.
- The relationship of science process skills and the variables of sex, race, past performance in science, intelligence and achievement was not significant in the inquiry course, and
- A significant relationship was found to exist between the variables of sex, race, past performance and attitude toward science.

8. "Inquiry as a method of teaching and learning science in elementary school". (Faraj Mohammad Abduljabbar, Ph.D., Michigan State University, 1986)

The study compares the Inquiry method of teaching science with the traditional method in the elementary schools of Kuwait. It was found that the means of the scores of the students who learnt by Inquiry method were
significantly higher than the means of the scores of students who learnt by the traditional method.


The experimental classes (seventh grade) were randomly assigned to one of the treatment condition (Inquiry Training Model) in the biology classes for the period of one academic year.

No significant differences were found within the three experimental groups on the achievement of knowledge gain and inductive thinking, but the students in the Inquiry model achieved significantly better than those involved in the expository model on divergent thinking skills.

10 “Effectiveness of Advance Organizer and Inquiry Training Models for teaching social studies to Class VIII students”. (Pandey, S.N., Ph.D., B.H.U., 1986)

The major findings were:

- The treatment had different effects on the pupils’ achievement,
- The difference in the means of gain scores in achievement due to Advance Organizers and conventional teaching was significant at the 0.05 level
- Difference due to Inquiry Training Model and conventional teaching was significant at the 0.01 level and the difference due to Advance Organizer Model and Inquiry Training model was not significant,
- There was no significant difference between the Advance Organizer Model and the Inquiry Training Model, Advance Organizer and the Conventional Teaching, in terms of pupil attitude towards social studies,
- Pupils reacted favourably towards the Inquiry Training Model and Advance Organizer Model.
The use of Graphic Advance Organizer to improve learning and retention of subject matter related to the mole concept.” (Mize, Andrea Gayle Pickard, Ed.D. The university of Southern Mississippi, 1989)

Results of the study do not support the use of graphic organizers as a strategy in teaching the mole concept at the high school level.

A high correlation was found between age, reasoning ability and students learning and retention of the concepts presented.

Comparative effectiveness of the Information Processing Models of teaching in developing certain concepts in chemistry at secondary stage.” (Aziz. Talat, Jamia Milia Islamia, 1990)

The study was conducted on a sample of 280 class IX students. Findings of the study are:

- Both boys and girls show better concept attainment when taught through information processing models than traditional lecture method.
- Chemistry can be effectively taught through model approach.
- Model approach of teaching is better than the traditional approach of teaching.
- Concept attainment model and inductive thinking model are effective for teaching science concepts.
- Bruner’s concept attainment model is effective for attainment of concepts.
- Mental ability of the students has no bars on the concept attainment as far as the students of higher and average mental ability are concerned.

Assessing differential effectiveness of Concept Attainment Model, Inductive Thinking Model and Inquiry Training Model of teaching on mental processes and attitude towards science through science teaching at class IX stage.” (Gupta, N.K., Jamia Milia Islamia, 1993)

Results of the study are that while the models of teaching have been effective in developing some of the mental processes like reasoning ability, scientific
creativity, and problem awareness ability, none of them was effective in developing persistency and inquisitiveness.


The objective of this study was to determine if a concept map used as an advance organizer could improve the science achievement of eighth grade students.

Sample: 82 students of class VIII in four science classes. The experimental group completed the concept map at the beginning of the science unit under the teacher’s supervision. At the end of the two-week unit, a science test was administered to the experimental and control group. A significant difference was found in the two groups. It appears that the concept map can prove to be a meaningful and structured approach for using advance organizer in the classroom.


The study was conducted on 150 students of class IX. Pretest and Posttest Equivalent Group Design (Campbell and Stanley 1963) was used for the study.

Main findings of the study are:

* Advance Organizer Model is significantly effective in teaching of biology in terms of pupil’s achievement.
* Biological Science Inquiry Model is significantly effective in teaching of biology in terms of pupil’s achievement.
* Advance Organizer Model is significantly more effective as compared to Biological Science Inquiry Model in terms of pupil’s scholastic achievement.
* Biological Science Inquiry Model is significantly more effective than Advance Organizer Model in terms of pupil’s interest in inquiry activities.
• Biological Science Inquiry Model is significantly more effective than Advance Organizer Model in terms of pupil’s reaction towards models of teaching.


The study was conducted on 300 class IX students of government aided schools. The design of the study was Pretest and Posttest equivalent group (Campbell and Stanley 1963)

Findings of the study are:

- For concept learning and retention in biology, Inductive Thinking Model and Inquiry Training Model are more effective than the conventional teaching methods.
- Inductive Thinking Model is more effective as compared to Inquiry training Model in terms of students' concept attainment in biology.
- Mental ability, Socio-economic status and previous scholastic achievement in biology have no bars on the concept attainment in biology.

16. Lantz (1982) studied the effect of Advance Organizers and subsumers on the understanding of solar energy concepts on class VIII students. He found that advance organizers benefited students of all subsumer levels on cognitive learning of solar energy concepts in immediate as well as delayed tests. Also, the presence of relevant subsumers in cognitive matrix benefited students in both immediate and delayed tests.

17. Stankiewicz (1984) studied the effect of Advance Organizer on the ability of the students to recall and apply facts after a visit to a science museum. Randomly selected science students of VII and VIII grades were selected for the study. The experimental group was treated with an advance organizer whereas the control group did not receive this treatment. The mean score on recall and
application questions of the experimental group was significantly higher than that of the control group.

18. Ghosh (1985) studied the relative effectiveness of two different types of advance organizers on the criteria of immediate learning. He found that the cognitive subsumption of the concepts in Life Science was facilitated by the advance introduction of relevant subsuming concepts and pictorial type of advance organizers enhances learning and retention. He also found that cognitive subsumption of complex subject matter depended on learning readiness and difference in cognitive style produced difference in cognitive subsumption of the learning task.

19. Passi, Singh and Sansanwal (1985) conducted a study on teacher educators using Concept Attainment and Inquiry Training Models with the objective of developing, implementing and adopting training strategies using these models. Findings of the study were that both the models brought about significant favourable changes in the attitudes of teacher educators as well as student teachers towards the models.

20. Bhaveja, Bharati, (1989) conducted an experimental study on the information processing models of teaching in schools of Delhi. She compared Concept Attainment and Inductive Thinking Models with the traditional method of teaching. She found that Concept Attainment and Inductive Thinking models were effective in inducing thinking and were more effective than the traditional method of teaching as far as learning and retention in biology is concerned. Inductive Thinking models were found to develop mental abilities like differentiating, comparing and contrasting, interpreting, inferring and extrapolating or generalizing.

21. Sushma (1987) studied effectiveness of Concept Attainment Model and Biological Science Inquiry Model for teaching biology to class VIII students. She
found that Biological Science Inquiry Model as well as Concept Attainment Model was effective for teaching biology to class VIII students and that the Concept Attainment Model was more effective than the Biological Science Inquiry Model in terms of students' achievement in biology.

22. Jaimini, Nirupama, 1991, studied the effect of teaching strategies on conceptual learning efficiency and retention to divergent thinking. (Ph.D., Edu., University of Delhi). She found that the Advance Organizer and Concept Attainment models were more effective than the conventional teaching methods in fostering the conceptual learning efficiency in terms of comprehension and application of concepts in chemistry.

23. Sharma (1986) studied effectiveness of Concept Attainment Model in terms of achievement of students on attainment test based on concepts taught in chemistry and effectiveness of Concept Attainment Model in terms of reactions of students towards the new methods of teaching.


25. D'Lima and Sugandhi (1986) conducted study on the willingness of the graduate student teachers to implement the Inquiry Training Model in actual classroom.


3.3. Studies related to Objectives of Science Teaching.


   The major findings of the study are:
   - The topics identified as very difficult by the pupils of class VI were, the structure of the cell, Protozoa, and classification of plants and animals.
   - Lack of facilities in school, lack of mastery of the subject matter on the part of the teachers, lack of experimentation in the classroom, overdependence of teachers on text books, overcrowding in classrooms, were listed by the pupils as some of the reasons for finding biology a difficult subject.
   - The ability to analyze materials by simple techniques had not been developed among the pupils to a desired extent.

2. "Prediction of the science inquiry skill of seventeen-year-olds: A Test of Educational Productivity Model." (Rekow, Steven James, Ph.D. University of Minnesota, 1984)

   The study was designed to investigate the influence of student characteristics and classroom characteristics on students’ inquiry skill.
The first purpose of the study was to test the effectiveness of the model of Educational Productivity for predicting the inquiry skill of 17-year-olds. The results of this study indicate that this model was capable of accounting for between 24 and 32 percent of the variance in inquiry skill for the general population of 17-year-olds.

The second question posed by this study asked whether the prediction of inquiry skill differed for males and females. While there was some difference in the contribution of the minor predictors, there was very little difference in the prediction of inquiry skill for males and females using the model of Educational Productivity.

**Objectives:**

1. To prepare verbal and non-verbal instructional materials.
2. To assess the effectiveness of the instructional material on the development of creativity of students.
3. To compare the gains of male and female students in creativity after treating them with verbal and non-verbal instructional materials.

**Sample and Methodology:** 160 students of class IX were divided into two groups: Verbal (80) and Non-verbal (80) having 40 experimental and 40 control in each group. Experimental and control groups were matched against creativity and intelligence variables. The study employed a pretest-posttest experimental-control group design.

**Findings:**

- The posttest creativity mean scores of students of verbal and non-verbal experimental groups were significantly higher than those of verbal and non-verbal control groups.
- The posttest mean scores of male and female students were not significantly different in any of the four aspects of verbal creativity and
four out of five (fluency, flexibility, originality and total creativity) aspects but in elaboration aspects, girls performed better.

- The mean posttest scores of high and low SES students of verbal and non-verbal experimental groups have no significant difference.
- There was no significant difference in the posttest scores of initially high and low in the verbal experimental group. For the non-verbal experimental group there was no significant difference in fluency, flexibility, originality and total creativity but in elaboration, initially low scored better.

4. "To study the scientific attitude and cognitive styles of higher secondary students." (Dani, D.N. 1984)

Objectives of the study:

i. To measure the scientific attitude of the higher secondary students.
ii. To find out the cognitive styles of the higher students.
iii. To compare the scientific attitude and cognitive styles of boys and girls; village, bid city and middle class town pupils; and science, arts and commerce students studying in higher secondary classes.
iv. To investigate the relationship between the scientific attitude and cognitive styles of the higher secondary students.

Findings:

- About 79.7% pupils possess scientific attitude. 30.4% possess high scientific attitude, 3.8% very high scientific attitude and 45.5% possess moderate scientific attitude.
- Boys and girls do not differ significantly in scientific attitude score.
- The scientific attitude of science students is significantly higher in comparison to that of arts and commerce students.
- The 'field dependent- independent' ability is significantly related to the scientific attitude in general and cognitive aspect of scientific attitude in particular.
• The cognitive style scores can be predicted both on the basis of scientific attitude scores or the cognitive part of the scientific attitude scale with 3.9% and 4.9% efficiency only. Regression is significant at 0.01 level of confidence.

5. "Effectiveness of Inquiry Training Model in developing scientific attitude among school children." (Aloni, Archana. Ph.D., Nagpur University)

Objectives of the study:

i. To ascertain the extent to which the traditional methods were effective in developing scientific attitude among school children.

ii. To determine the effectiveness of Inquiry Training Model for developing various dimensions of scientific attitude.

iii. To determine the effectiveness of Inquiry Training Model in developing scientific attitude among school children.

Findings of the study are:

• Traditional methods of teaching were not much effective in developing scientific attitude among school children.

• The Inquiry Training Model was effective in developing various dimensions of scientific attitude. The dimensions, which were developed to a remarkable extent, were - Freedom from bias, seeking evidence, observation, freedom from superstitions, cause and effect relationship and criticality. The dimensions, which were developed to a small extent, were empiricism, open-mindedness and curiosity. Inquiry Training Model was not effective in developing intellectual honesty among the students.

• Inquiry Training Model was superior to traditional strategy for developing scientific attitude among school children.

Findings of the study are:

- The Hypothesis making ability (HMA) and Hypothesis Testing Ability (HTA) are significantly correlated with intelligence but the correlation between HMA and intelligence is not as high as the correlation between HTA and intelligence.

- Co-efficient of correlation between HMA and creativity is higher as compared to HTA and creativity. While fluency factor is an important determinant of HMA, originality is an effective component of HTA.

- The socio-economic status level has higher degree of relationship with HMA than it has with HTA.

7 "Development of some personality correlates of scientific creativity". (Yawalkars, Vibhayari 1985)

Yawalkar studied the efficiency of two creative teaching techniques viz. Bionics and Morphological Analysis, in creating conducive conditions for development of personality correlates of scientific creativity. The personality correlates were emotional, venturesome, strong superego strength, self-reliance, and dominance.

Findings: - The traditional method of teaching has shown general decline in the development of all the five personality traits under study, whereas Bionics and Morphological Analysis as teaching techniques have shown positive gains in the development of five and three personality traits respectively. Thus of all the three teaching techniques used in this investigation, Bionics may prove to be the most suitable teaching technique for the development of personality traits related to the scientific creativity.

8 "A study of relationship between the creative thinking abilities of student – teachers and their classroom verbal behaviour". (Satya Chowdhry, Delhi University 1981)
Findings: - The verbal creative thinking abilities of teacher trainees are positively correlated with their figural creative thinking abilities.


10. Dubey K.K. (1992) attempted to measure scientific temper in his study on ‘Scientific temper and its measurement’. He concluded that whereas all groups of students showed scientific temper, significant differences were observed between male and female science teachers.

11. Menon (1986) studied the Gujarat Secondary Education System from the angle of process of scientific inquiry. He fixed the norms of the development of the process skills of science inquiry among students through a multi cross-sectional survey. He studied the overall impact of the curricular systems on the development of process skills of science inquiry and examined textbooks of classes viii to xii from the point of view of evaluation and instructional practices.

12. Jhag (1979) found scientific creativity was normally distributed. Creative children were found to be better in abstract thinking, emotional stability, independence, self-sufficiency, self-concept and intelligence and were more venturesome, relaxed, controlled and doubting.

13. Paramesh (1970) has reported that creative persons are characterized by theoretical and aesthetic values. The creative persons neither extraverted nor introverted. They are neither high nor low in anxiety or neurosis.
14. Passi and Lalitha (1975) have conducted a factorial study of creativity, intelligence and self-concept of adolescents, to find out the relationship between creativity and intelligence as well as creativity and self-concept.

15. Jawa (1971) and Jacob (1972) have studied the relationship between achievement motivation and creativity.


17. Mallapa and Upadhyaya (1977) have studied the relationship between personality and creativity.

18. Field (1972) studied creativity and cognitive style of science students. He has suggested that both, stable inquiry and fluid thinking are part of the thinking process in creative science activity.

19. Taft (1976) studied the correlation between creativity, intelligence and school examination results and observed that creativity and performance in science examination were having lower correlation than the correlation between the cognitive tests and performance in science examination.

20. Bhandauria (1980) found that the gifted students had better creative potential (on verbal and literary problems, creative production, originality, adjustment and spontaneous flexibility, positive self-concept).

21. Telegaonkar (1984) developed teaching strategies to encourage students to solve problems in scientific creativity.
22. **J.K. Sood (1974)** studied the attitude towards science and scientists among students and teachers and found the understanding of science positively related to it.

23. **N.N. Srivastava (1980)** measured scientific attitude and found that the amount of scientific knowledge or general exposure to science courses made an impact on scientific attitude.

24. **Sunita Garg** studied decision making in children using games like lucky seven, skill chance, dice game, card guessing, probability learning game, etc. She found that:
   - Decision-Making under risk and under uncertainty was different.
   - SES, age and sex of children intervene in decision-making.

25. **Saxena (1980)** studied decision-making ability of students in relation to their problem solving ability.

26. **N. Srinivasan** studied the operational features of multi-objective decision-making.


28. **Aranha, Joyce (1988)**, conducted an experiment in mastery learning in science in his Ph.D. on Education from the ‘Maharaja Sayajirao University of Baroda.

29. **Kumar U.S. (1991)** showed that the development of scientific attitude of students depended upon their perception of science teaching and nature of learning experiences.
Nellaippan (1992) studied both attitude and interest within the context of learning environment and showed that the various components of the learning environment are significantly related to both scientific attitudes and interests. He also found that the sex and locality of the students do not influence their scientific attitude and interests.

Almost all the studies related to the information process models indicate that these models are more effective than the traditional mode of teaching in terms of students' achievement in different content areas and also in terms of developing mental abilities, scientific attitude and creative abilities.