CHAPTER -II

REVIEW OF RELATED LITERATURE

2.0 Introduction

Bruce Tukman says that review of related literature is an essential device for developing an advocate research spectrum. Thus keeping in view the importance of review of related literature, this chapter has been denoted to the same.

Since the present study aims to compare the relative effectiveness of the Concept Mapping Model and Concept Attainment Model. Therefore, the investigator extensively probed into the vast expanse of research conducted on these Models. This has yielded such enormous volume of data that it is difficult to decide upon the studies to be reviewed. For the purpose of objectivity and simplicity, the related research was categorized into two groups - one group comprising studies related to Concept Mapping Model and the other group comprising studies related to Concept Attainment Model outside India and within India. The aim of this entire exercise of reviewing
the literature was to provide direction and evolve a rationale for formulating hypotheses for the present study.

2.1 Studies Exploring the Effect of Concept Mapping

2.1.1 Studies related to Concept Mapping Outside India

Initial Studies: Cardemone (1975) made the first use of concept maps. He found that the preparation of a "master" concept map for the topic of 'ratio and proportion' helped him to plan instruction on this topic. Bogden (1977) also found that concept maps prepared by him in a Genetics course were found to be valuable in learning the course by a small minority of students. The concept maps used by Cardemone (1975) and Bogden (1977) did not have words on the linking lines between concepts. In the years to follow, the fate of Concept Mapping existed in a dilemma till 1984, when Novak and Gowin (1984) gave the concept maps their present shape and carried extensive experiments with Concept Mapping in the school teaching learning process. Since then the Science of Concept Mapping has grown at an exponential pace.

2.1.1.1 Studies related to cognitive gain

The data available from Novak D. Joseph (1984) and his students' research studies, both qualitatively and quantitatively, strongly supports the value of concept maps for both cognitive and affective gains. During the period 1985 to 1987, Novak himself taught Concept Mapping in classroom settings to upper elementary and secondary school children. His co-worker Moriera (1977) had also used concept maps with university students. Their first comprehensive study utilizing concept maps and vee diagram was
conducted with junior high school students. The findings of this study were in line with the findings of researches conducted by Novak et al. The study led to the following conclusions:

a. Classroom teachers motivated to use new metacognitive learning strategies can be successful in employing Concept Mapping vee diagramming tools with junior high school Science students.

b. Skill in the use of these tools takes time, perhaps one or two years if used only in a single course.

c. Conventional measures of students' ability/achievement are poor indicators of success with use of these strategies.

d. Novel problem solving success is significantly correlated with success in Concept Mapping scores.

e. Junior high school students have become adapted to primarily rote mode learning and it is not easy to move them to meaningful learning strategies.

**Lavie Bar and Zain Ben (1990)** studied the effectiveness of Concept Mapping in enhancing meaningful learning in an Environmental Education programme. The research involved a case study of learning and educating 63 grade XI students. Gowin's theory of 'educating' and Ausubel Novak's theory of 'meaningful learning' provided the basis for the study. The knowledge claims of the study were: Even a short course of 'learning how to learn' has a significant impact on moving students towards meaningful learning; 2) Rote learners failed to affect successful integration between
concepts while meaningful learners established new connections and new meanings; 3) Integration of thinking, feeling and acting is associated with meaningful learning and 4) Concept Mapping and interviewing are far more sensitive and accurate evaluating tools than the 'objective' tests used in the study.

Cullen J (1990)\textsuperscript{1}, Heinze-Fry, J. and Novak, J. (1990)\textsuperscript{2} discussed the use of Concept Mapping as a tool to enhance meaningful learning for college science students. Student attitudes toward Concept Mapping are also described and it is helpful in overcoming misconceptions in science.

Wandersee James H. (1990)\textsuperscript{3} studied that concept maps are designed to find out what the learners already know about a subject administered to the "life zone" inventory and asked to develop a post instruction concept map on marine life zone. Conclusion of the study was that concept maps can offer rich and detailed insight into the extent of meaningful learning resulting from class room instruction, results also suggest that Concept Mapping is valid and potentially useful technique for documenting and exploring conceptual change in biology.

Wallace Josephine D. and Mintzes Joel (1990)\textsuperscript{4} of the University of Carolina examined the concept maps as vehicles for documenting and exploring conceptual changes in Biology. Students (N=91) who enrolled in elementary Science method course were randomly assigned to one of the two treatment groups. Subjects in both groups were administered a multiple choice/free response inventory whichassayed their knowledge of "life zones in the ocean". Those in the experimental group subsequently received 45
minutes of computer assisted instruction on marine life zones on the basis of Concept Mapping, while those in the control group received lecture method as exposure to related topic. Upon completing the instructional sequence, both groups were interviewed. Instructed students showed substantially more valid conceptual understanding and fewer invalid concepts (misconceptions) than uninstructed students did.

**Stensvold Mark S. and Wilson T. John (1990)**\(^1\) conducted a study on effectiveness of Concept Mapping and found Concept Mapping enhances the student's achievement.

**Okebukola Peter Akinsola (1990)**\(^2\) of the Lagos State University, Nigeria examined the potency of Concept Mapping technique to attain meaningful learning of concepts in genetics and ecology. The Experiment; 138 pre degree biology students (75 boys and 63 girls) of Lagos State University were involved in the study. With the mean score of 28.12 on the post test of the test of meaningful learning in genetics, the experimental group students who group out-performed the control group. The means and standard deviation of the score of students on the test of meaningful learning in Ecology show that experimental (25.98) and control (19.11) groups did not differ merely due to chance factor \(t (136) =12.278; p < 0.001\)

**Conclusion & Implications;** The study provides proof in favor of Concept Mapping techniques in bringing about learning genetics and Ecology in a meaningful manner. Besides the learners, the study has direct implications for Biology Educators. They should be aware of the utility value of Concept Mapping approach in the teaching-learning scenario
Pankratios William J. (1990) discovered that direct teaching of problem solving method to high school science student met with little success. The experiment; six intact high school classes taught by the investigator took part in the study. A one way analysis of variance indicative a significant main effect for the treatment at the point five level. A pair of single df comparison of the adjusted treatment means resulted in significant difference (p < 0.5) between the control group and the average of the treatment means as well as between the two experimental groups. It can be concluded for high school student that mapping concepts prior to during and subsequent to instruction led to great achievement as measured by post test scores. The study reveals that Concept Mapping has undoubtedly a positive effect on achievement.

Briscoe C., Lamaster S.U. (1991) found positive effect on meaningful learning in biology. They selected few concepts from college biology and taught students through Concept Mapping and found that Concept Mapping enhances the meaningful learning.

Barenholz H. and Tamir P (1992) selected twenty to thirty concepts as key concepts for a course in microbiology. They taught the students using Concept Mapping strategy. Paper, pencil response was used to take responses. Students show remarkably well in construction of concept maps. Hall, Dansereau and Staggs (1992) assessed recall of information in the form of normal text or Concept Mapping. The researchers found a significant difference favoring Concept Mapping as a tool in biology concepts.
Novak D. Joseph and Dismas Musonda (1992) assessed a twelve-year longitudinal study of Science concept learning. The experimental group, comprising 191 students, was imparted instruction using audio tutorial Science lessons based on Concept Mapping. The purpose of this study was to examine the use of Concept Mapping as a strategy to facilitate meaningful learning based on a theoretical structure. The effect of this instructional strategy was assessed in terms of comparative group means on cognitive learning. Companies were made on method, prior knowledge and gender. Attitudinal changes were also examined. The study utilized pre-test/post-test true experimental design. Analysis of the outcome also included the interaction of students' cognitive performance level and their abilities to use Concept Mapping strategies. The study involved 429 Science students of IX grade in two selected junior High schools. The experimental findings reveal that Concept Mapping group did slightly well on the content post test than the conventional group.

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Lambiotte J. and Danseau D. (1992)\(^3\) compared Concept Mapping and lecture Method on secondary school students. They found that students with more well established schemas for the circulatory system when given knowledge through Concept Mapping treatment, Concept Mapping found more effective than lecture method.

Willerman Marvin and Macharg Richard A. (1992)\(^1\) studied the concept mapping as a Model. The objective of this study was to determine if concept mapping used as a Model it could improve Science achievements of eighth grade students. The Experiment: The experimental group (n=40) was presented with concept mapping, as a model at the beginning of a Science unit. The control group (n=2) was not presented with the concept mapping. The instrument used to measure academic achievement was a teacher made test. The objective type questions were at all levels of Bloom's Taxonomy except synthesis and evaluation. Results: One tailed t-test was used to
compare the experimental and control group scores. The results indicate that
the use of Concept Mapping produces a significant increment in academic
gain for students in eighth grade.

**Horton P.B., McConney A., Gallo, Woods, Hamlie (1993)**\(^2\) studied the
effectiveness of concept mapping as an instructional tool and found Concept
Mapping enhances the achievement of students in the subject of science.

**Lamar James Bagget (1993)**\(^3\) studied the effectiveness of Concept
Mapping as advanced organizers. The subject in the study was 111 students
from six intact Biology classes in a southern Mississippi community school.
One control group and two concept mapping experimental groups were used
in the study. A pre-test post-test experimental design was used. Multiple
linear regression analysis was employed to test the hypothesis at 0.05 level
of significance. The results showed that the two experimental groups
outperformed the control group in attaining concepts of Biology
(Photosynthesis)

**Rafferty (1993)**\(^1\) discusses the construction of concept map to enhance
concept learning. **Leary Frech Rose Marry (1993)**\(^2\) in her Ph.D.thesis
considered the effect of concept maps on concept learning in high school
Chemistry. Specifically, achievement in the area of concept learning,
conceptual problem solving and numerical problem solving was investigated
to determine what relationship existed between concept learning and
problem solving for these students. Two instructional groups were created.
The first was instructed in conventional method. The second received
instruction identical to the first group with the supplementation of concept
mapping activities. It was found that the scores of students in the Concept mapping group with higher scientific reasoning out perform the scores of students in the control group in chemistry concept learning. A significant relationship between concept learning and numerical problem solving was found in the Concept Mapping group only, thereby supporting the theory behind the Concept Mapping strategy. Roth W. M. and Roy Choudhry A. (1993)\(^3\) use concept mapping for the collaborative construction of knowledge on high school physics students. They found that Concept Mapping enhances the knowledge of the students.

**Jaffery Austin Jay (1994)**\(^1\) conducted research to study the effectiveness of Concept Mapping in a college level Biology course. The research designs allowed for a comparison between experimental and control groups in regard to achievement and found it in the positive direction. A majority of experimental group participants agreed that the Concept Mapping strategy aided them in identifying connections between concepts, provided them with a way to gain an integrated view of the subject matter, and made them active rather than passive learners. Many experimental group participants constructed concept maps collaboratively and, in turn, suggested that collaborative Concept Mapping should be infused within the Cell Biology course in the future.

**Markham and Mintzes (1994)**\(^2\) highlighted the difference in traditional scores and Concept Mapping scores as signifying that Concept Mapping is helpful in meaningful learning in the science subject. They carried their study on elementary school students examining the extent to which differences
exist in the concept maps of advanced college biology majors (n=25) and beginning nonmajors (n=25) in the domain of mammals. Results indicate that the Concept Mapping is more effective

Pendley B.D., Bertz, R.L. and Novak J D (1994)\(^3\) use Concept Mapping as a tool for learning chemistry and favours Concept Mapping to use for enhancing achievement in chemistry. Esiobu, Soyibo (1995)\(^1\) studied the effect of Concept Mapping on cognitive achievement in ecology and genetics. They found that students studied with Concept Mapping learning mode achieved more in the ecology and genetics rather than other mode of learning.

Smith K M and Dwyer F M (1995)\(^2\) also favours to use Concept Mapping strategy to increase student achievement.

Schmid R.F., Telaro G. (1996)\(^3\) use Concept Mapping as an instructional strategy for high school biology and found that Concept Mapping changes the scores of the students in the positive direction. They emphasize to use Concept Mapping for meaningful learning.

Markow and Lonning (1998)\(^4\) tested the effect of Concept Mapping in college chemistry. The researcher found that the students had a strong positive attitude towards the use of Concept Mapping for a better understanding of chemistry concepts. Merrit , Ronald L., Jr. (1998)\(^5\) studied the effect of Concept Mapping on Precalculus students of Community college and found that their conceptual understanding of Inverse functions improved remarkably Santhanam, E., Leach, C., &
Dawson, C. (1998)\(^6\) studied Concept Mapping on achievement in genetics in introductory classes of genetics in Australia and found positive results.

1. Esiobu, Soyibo (1995), Effects of concept and vee mapping under three learning modes on student's cognitive achievement in ecology and genetics, Journal of research in science teaching 32(9), 971-995.


Williams C.G.(1998)\(^1\) used concept maps to assess conceptual knowledge of function in mathematics and found significant difference favoring Concept Mapping as a tool for achievement.

Mc clure , Sonak and Suen ( 1999 ),\(^2\) Sorensin, McDermott Piternick and Rosenquist (1980) who found that Concept Mapping based instruction
in Science is more effective than lectures for students. Baroody A. and Bartels B. (2000)\textsuperscript{3} used concept maps to link mathematical ideas in their study. Seven concept map attributes are used for scoring concept maps—prepositions, hierarchy, branches, crosslinks, examples, degree of conceptualization, Differentiation of concepts and recommend implementation of Concept Mapping as a teaching tool in Secondary and Post secondary mathematics and found remarkable improvement of students after using Concept Mapping.

The positive impact of the use of Concept Mapping on learning process was studied by Kinchin (2000a,2000b)\textsuperscript{4}, Sjostrom M.P. (2000), Wilcox S.K. and Lanier (2000)\textsuperscript{5}, Wood S. (2001)\textsuperscript{6}, Harnosch D.L., Sato T., Zheng P., Yamaji S. and Connell M. (2002)\textsuperscript{1} Hibberd R., Jones A. and Morris E. (2002)\textsuperscript{2} and Safayeni Frank, Derbentseva Natalia, Canas Alberto (2003)\textsuperscript{3} they found that Concept Maps are most beneficial in the learning process, they are able to reveal students' misconceptions in learning that are not captured by traditional method, means to promote and assess knowledge acquisition.


2.1.1.2. Studies related to other areas

i) Studies related to motor skills facilitator

The following studies have been made under this category
Taylor Robertsen (1985) utilized concept maps and vee diagrams in a study to see if students could be helped to acquire a meaningful understanding of laboratory work. Her earlier research (Taylor, 1984) showed that laboratory instruction needs to be meaningful, rewarding and emotionally satisfying. She taught two laboratory sections - one was the experimental group, where students were instructed briefly in Concept Mapping Vee diagramming technique and the other was the control group in which instruction was devoid of these two methods. Taylor found that on the objective course examination, the experimental group scored somewhat better than the control group. Where the truly significant difference occurred, was in the students' feelings and attitudes towards Biology and Biology laboratory studies. Novak's experiences with Education and Edmandson's (1985) work plus research done by co-workers on met cognitive learning on secondary and freshman college students led to the same conclusion and also added that it discourages the rote learning.

ii) Studies related to curriculum development

The following studies have been made under this category

In the area of curriculum development, Novak and Gowin (1984) suggested concept maps can be used in curriculum development. Driver and Oldham (1986) found that concept maps effectively reflect current trends in Science curriculum and that the concept maps mirror the constructivist definition of curriculum as a set of learning experiences which enable the learners to develop their understanding. Leahy (1986) uses concept maps to develop guides to literature curriculum. Posener and Rudnitsky (1986) also suggest the use of concept maps as a part of curriculum development process.
Pankratius (1987; 1990)\textsuperscript{2} has used Concept Mapping in the high school Physics curriculum in an attempt to improve both instruction and learning. Glaserfeld Van (1989)\textsuperscript{3} emphasized the importance of social interaction in promoting conceptual change in the curriculum of science and mathematics. He suggests that this is the main cause that many constructivist teachers of Science and Mathematics have been promoting group learning. He further found that concept Mapping when clubbed with group learning showed promising results.

Starr L.Mary & Krajcik S. Joseph (1990)\textsuperscript{4} of the University of Michigan explores the use of concept maps as a tool for science curriculum development and discusses the changes that occur in teacher's view of the curriculum development with successive revision of the maps. Concept maps have been used in the study, in curriculum development from grade fourth to eight. The use of concept maps can help science teacher develop science curriculum that is hierarchically arranged, integrated conceptually driven, the method described in the study allows for improvement in both the process and product of curriculum development.

iii) Studies related to psychological concepts

The following studies have been made under this category

The results of recent studies in the use of Concept Mapping heuristic seem to demonstrate that meaningful learning results through its use in Science education. While this underscores the need to use more effective instructional strategies in Science teaching, the issue of intervening variables
like anxiety in learning and Science achievement and the possible use of a metacognitive strategy in anxiety reduction have not been addressed. The study by Jegede J Olugremiro and co-workers (1992) sought to find if the metacognitive strategy of Concept Mapping reduces anxiety and thereby enhances achievement in Biology. The Experiment: A total number of 51 students (30 boys, 21 girls) of grade X of Demonstration Secondary School of Ahmadu bello University form the sample of the study. Two classes were randomly sampled and assigned to two groups -Experimental (N=22) and control (N=29) group. Anxiety was measured by using the version of Zuckerman's test (1960). A pre-test post test experiment with random assignment was employed. Gender and groups were crossed in a 2x2 factorial design, with achievement and anxiety as dependent variables, to examine the influence of anxiety on achievement in biology through Concept Mapping strategy. The Study revealed that the experimental group achieved comparatively better than the control group, (ii) the Concept Mapping strategy led to a significantly greater reduction in the anxiety level, iii) the male subjects had a lower anxiety level than the females and (iv) the treatment by using concept Mapping helped to reduce anxiety level to a slightly greater degree in the male subjects than in female subjects.

Franklin Edward Carl (1992) of the Ohio State University conducted an experiment to test the effects on Concept Mapping on Science anxiety and acquisition of scientific knowledge among grade VIII students low in integrative complexity. A 2X2 factorial design was used to study the effects of Concept Mapping on Science anxiety and Science achievement for 145
students. A multivariate analysis found that Concept Mapping makes a significant difference in Science achievement but not in science anxiety. The other findings include significantly higher level of anxiety for females in the Concept Mapping group than the females in the neutral group, except for laboratory related activities where the reverse was true. The conclusion of the study was that Concept Mapping as implemented did not have any significant effect on anxiety but had some effect on Science achievement.

Various studies on the interaction between anxiety and instructional methods have revealed negative correlation between anxiety and students' achievement as well as between anxiety and realization of important cognitive and effective outcome. Fraser, Nash and Fisher; (1983), Jegde (1990), Jegde and Okebukole (1990). Lehman, Carter and Kahle (1990) studied the affective outcome on achievement in Science instruction by using Concept Mapping. Novak, Gowin and Johnsen (1983) reported: "although higher ability students tend to do better in Concept Mapping, good or poor concept maps were achieved by students of all ability groups"

iv) Studies related to problem solving skills

The following studies have been made under this category

Penallo R. Hennery (1993) studied the effect of Concept Mapping and cooperative learning on achievement, transfer problem solving abilities and attitude towards the instructional experience of middle school Science students. In the six-week study, after first three weeks, selected measures of Science achievement transfer problem solving ability administered and after
six weeks, the other Science achievement (ANOVA) conducted for all content units and revealed that concept maps constructed in co-operative learning groups were less likely to have un-connected concepts or unlabelled propositions. They were less likely to contain errors or lack logical connections. Then examine for readability, maps constructed co-operatively was easier to follow then maps constructed individually, thus suggesting a better overall understanding of concepts.

v) Studies related to teacher education programme

The following studies have been made under this category

Novak & Arnold Davis (1994) studied the relative effectiveness of co-operative Learning and Concept Mapping in a pre service teacher education course. The study investigated separately the effects of Co-operative Learning and Concept Mapping as a primary instructional strategy within a pre service teacher education course in the province of Manitoba. A total of 140 grade IX students participated in the study. Low verbal ability students are likely to benefit more from Concept Mapping since low verbal ability students may also be affected by the distracting features of the laboratory. Concept mapping may provide them with the means to attend to important information in the activity. High ability students performing Concept mapping achieved lower scores on comprehension test than similar ability students who did not construct concept maps. Since high ability students may prefer to use a rote style of learning, very different from that required to construct an articulate concept map. One specific way to do this is to encourage these
students to reuse their concept maps periodically during the laboratory activity.

**Ferry, B., Hedberg, J. and Harper, B. (1998)**² studied preservice teachers' use of a concept-mapping tool to create concept maps about science-related elementary curriculum-content knowledge. The process enhanced their skills in planning instruction.

In regard to preparation for elementary Science teaching, recent authors *(Beyback, Dismore, Flood, Gooding, Swift, Wattier and Weber; 1992, Nullis and Jenkins; 1990¹ and Tobin 1998)**² have indicated that elementary teachers have difficulty in using Concept Mapping technique with students because they themselves have not experienced this method as learners in Science classes. Similar arguments have been put forth to explain teachers' hesitancy to incorporate computers in their teaching *(Dossey, Mullis, Lindquest and Chambers; 1990)³.*

**Gordon, C.A. (2000)**⁴ studied library research activities of 10 college-bound Tenth-graders; half who used Concept Mapping with library instruction and half who had library instruction only. The results showed that concept mappers search more thoroughly and more efficiently.

### 2.1.2 Studies related to Concept Mapping in India

#### 2.1.2.1 Studies related with cognitive gain

There is less number of studies related with cognitive gain in India.
Lakshmi (1997) studied the effectiveness of Concept Mapping in teaching mathematics to ninth grade students and concluded that Concept Mapping is effective in learning of concepts in mathematics.

Kalaiyarasi (1998) used Concept Mapping as teaching strategy to teach Higher Secondary Students in Botany and concluded that Concept Mapping as teaching strategy is effective in Botany to learn the concepts.

Gupta Vandna (1999) compared the effect of Concept Mapping and Inductive Thinking Model on concept learning efficiency and retention. 111 ninth class students [girls] from three different schools was the sample of the study. The following conclusions were arrived at:

1) The CMM and ITM as teaching strategies are significantly more effective than conventional method in fostering the conceptual learning efficiency

2) The concept learning of the pupils is significantly influenced by the interaction of their divergent thinking ability with the teaching strategy they are exposed to.

3) An in-depth study of the concept learning further suggests that although statistically not significant yet comparatively the CMM is more effective in concept learning to pupils with high divergent thinking.

4) The concept retention of the pupils is significantly influenced by the teaching strategies they are exposed to.

5) The CMM is more effective in retention of concepts rather than ITM.
Pongodi (2000) studied the use of Concept Mapping in Concept Attainment in Chemistry of class ninth students and concluded that the students of ninth class attain concepts in chemistry more easily and effectively when taught through Concept Mapping.

Kumudha (2000) compared the effectiveness of lecture method and Concept Mapping strategies in Physics taught to Higher Secondary students and concluded that CM strategy is more effective than lecture method in teaching of Physics. Higher Secondary students learn concepts more easily through Concept Mapping strategy.

Kharatmal M., Nagarjuna G. (2005) studied the effect of concept mapping as knowledge organizer in the mathematics and found that for meaningful learning Concept Mapping is an effective instructional tool.

Ahuja Amit (2007) studied the effectiveness of Concept Mapping as an instructional tool in learning and retention of concepts among students as co.

Bhandage G.T. and Ravichandran R. (2007) studied the effect of Concept Mapping on misconceptions in the topic Chemical Equilibrium. Random Sampling was done from three different levels of learning the selected 251 students from 11th class to degree courses. Concept Mapping was effective in finding the misconceptions about Chemical Equilibrium and to solve them.

Chandra Dinesh Mayuri (2008) studied the effectiveness of Concept Mapping on science achievement of secondary school students and researcher also find the effect of Concept Mapping on scientific aptitude and
problem solving ability. Researcher found that Concept Mapping was effective in enhancing the achievement and problem solving ability of the students.

2.1.2.2 Studies related with other areas

i) Studies related to Language

The following studies have been made under this category

Manoj (2004)\(^3\) compared the effect of CMM and ITM based teaching on pupil’s achievement in English Grammar. Sample and Method - The sample consisted of 120 pupils of eighth class of three sections of same school of Delhi. One section form the control group and the other two sections formed the two experimental groups, one each given instruction in CMM and ITM respectively. A SES scale (urban) by Dr. S.P. Kulshreshtha was used to equivalent compared to conventional method of instruction. The researcher found Concept Mapping is an effective instructional tool in learning and retention of concepts as compared to conventional method. the samples and after treatment with English Grammar lessons ANCOVA is used to adjudge the significance of the teaching strategies.

The following conclusions were drawn from the findings -

1) English Grammar achievement scores of experimental groups were more than the students who were taught through conventional method.

2) The CMM has shown significantly higher achievement than ITM

ii) Studies related to teacher education programme

The following studies have been made under this category
Rajammal (1996) studied the use of Concept Mapping strategy to B.Ed. trainees and concluded that Concept Mapping is an effective strategy in concept learning in teacher education programme.

The researchers have investigated the effectiveness of Concept Mapping Model in terms of pupil learning. While studying the effect of Concept Mapping Model independent variable e.g. socio-economic status, personality traits, cognitive development of students etc. have been considered. Investigators have also tried to find out the effect of different types of organizers, varying length of organizers and presentation of organizers at different time of lesson. 2.2 Studies exploring the effect of Concept Attainment Model

2.2.1 Studies related to CAM outside India

Initial Studies

Nicholson (1966) concerned with the logical structure of a concept and the efficiency with which early adolescence attain conjunctive and disjunctive concept, when varied stimuli are used, had a sample of 80 young adolescents from the 9th grade of a military school. He found that when varied stimuli used, it increases the efficiency of the learner to attain concepts.

2.2.1.1 Studies related to cognitive gain

David (1973) studied the effects of presenting new concepts in 230 words prose passages. The sample consisted of 66 tenth grade students. It was concluded in case of learning concepts from prose materials involves complex
combination of factors and CAM was effective in enhancing conceptual understanding.

**Bordelon (1978)** assessed the effectiveness of Concept Attainment Model on reading comprehension and listening comprehension. The sample consisted of 40 sixth grade students. The Pearson product moment coefficient of correlation, concept attainment test and the Cattle Culture Fair Intelligence Test were utilized. The findings show that there was significantly difference in scores when taught through CAM in the positive direction.

**Rollins (1980)** determined the degree to which Texas High School seniors attained 5 selected Earth Science concepts. The sample consisted of random selection of 5 seniors from 100 Texas High Schools. Frayer Concept Analysis Scheme and the Klausmeier Model, a 12 item test constructed by the author, was utilized. The findings show that seniors from schools in the second largest size range, male students, and students with more than 2 years of Science background attain significantly higher scores.

**Fulton (1981)** studied the effect of CAM used to teach science concepts of seventh grade students. The sample consisted of 186 students in five science classes. Science concept test developed by the investigator. The findings showed that there were significant mean score differences between the control group and experimental group. CAM was more effective for attaining science concepts.

**Lee (1983)** investigated the effects of conceptual development and the different presentation forms of concept attainment. The sample consisted of 511 male & female 10th grade students. A 2 x 2 factorial design was used. It was found that there was a statistically significant difference between
instructions based on the definitions and examples, and based on the examples only form. **Woodward (1985)** investigated the effectiveness of a CAM in enhancing students learning unit of health. The sample consisted of 30 mildly handicapped students. Post test experimental design was utilized. The findings indicated significant differences on basic facts and concepts that were taught through CAM. These differences were retained on a maintenance tests given two weeks after the post test. **Gryspeerdt Danielle (1991)**, **Moxness Katherina (1991)** studied the effect of CAM on learning and found that CAM more effective in learning of concepts. **Carlson Johnson, Kastl R. (1992)** and **Klausmeir (1992)** strongly recommended CAM for developing conceptual thinking in students. **Canady Robert, Rattig Michael (1996)** and **Stromdahl Helge (1996)** studied the effect of CAM on concept formation and concept attainment on science subjects. They concluded that CAM was more powerful than traditional method in concept formation and concept attainment. **Chunk (2000)** studied the effectiveness of CAM on achievement scores of students and found that CAM more effective in enhancing the achievement scores of students. **Feldman Jacob (2003)** studied human learning after the treatment of CAM and concluded that CAM was more effective than conventional method. **Nessel Devise, Baltas Graham, Joyce (2007)** studied thinking strategies as CAM for student achievement and concluded that CAM enhances students’ achievement and improves learning in different subjects. **Mandy Biggers, Talkmitt Susan (2008)** of Texas University studied the effectiveness of CAM on biology concepts. They found that CAM was more effective in
enhancing the learning of students. **Herbert Marsh and Alison Mara (2008)**\(^2\) of Oxford University studied the effect of CAM on attainment and achievement of post secondary students in the science concepts. They concluded that CAM was effective in enhancing the attainment and achievement of students.

### 2.2.1.2 Studies related to other areas

#### i) Studies related to Children with special needs

The following studies have been made under this category

**Henkin (1977)**\(^3\) investigated the first grade children on concept attainment and reading achievement, and the role of sex upon concept attainment and reading achievement. The sample consisted of fifty first grade children, Boehm Test of Basic Concept Form A, Gates Macginitie Reading Test, student t- test were utilized. The findings show that significant differences were there between two groups. CAM was more effective in attaining the concepts and enhancing the reading achievement. The sex did not have any significant effect on the concept attainment and reading achievement.

**Rottavina (1977)**\(^1\) investigated some cognitive skills and reading achievement correlated the social maladjustment across three chronological age groups. The sample consisted of low socio economic status youngsters from second grade 38, fifth grade 40 and a state operated institution for deliquesce 40. ANOVA anti test were utilized. The findings show that there was a greater importance of information processing at the adolescent level than at the elementary grade level. Reading achievement was more powerful than prediction of behaviour.
ii) Studies related to psychological concepts and strategies of learning process

The following studies have been made under this category

**Bachman (1979)**\(^2\) studied the relationship between cognitive style and concept attainment efficiency. The sample consisted of 160 male & female undergraduates. Cue preference test developed by the author, the hidden figure test, and scholastic aptitude test were utilized. He found that verbal ability, Cue relevance/saliency and task complexity are important mediators in the concept attainment efficiency and success.

**Shine man (1980)**\(^3\) investigated the effect on the information processing behaviour of student teachers having similar or different conceptual interaction of student teachers. The sample consisted of 32 student teachers and their co-operating teachers. Paragraph completion tests, a medium split and 2 X 2 pictorial designs were utilized. Significant differences were found between initial and final information processing behavior.

**Nuzum (1983)**\(^1\) developed an instructional package on the basis of CAM guide for teaching Arithmetic, story Problem Solving Skills and examined the efficiency of the model. Sample consisted of a single subject. He found that CAM which included instruction to mastery in analysis, task specific and procedural knowledge was responsive to the learning disabled in the study. Each subject problem solving performance improves substantially.

iii) Studies related to transfer of learning

The following studies have been made under this category
Piper (1986) explored the more opportunities for teaching science using CAM for transfer at the junior high school level of education within one school system. The sample consisted of 38 Science teachers including those in 7th grade Life Science, 8th grade Earth Science, 9th grade Physical Science and High School Biology. It was found that there was the possibility of the learning of the concepts being transferred on horizontal orientation (7th grade Life Science & 7th grade unified studies) and on a vertical orientation (From one level of Science to another, higher grade level of Science)

iv) Studies related to language and thought

The following studies have been made under this category

Kastle J. and Carlson Johnson (1992) researched that Concept Attainment Model was a way to help students in gaining an in-depth understanding of a particular broad concept. Model gives students the experience in conceptual thinking also. CAM was effective in enhancing thinking skills.

Biggers Mandy and Talkmitt Susen (1994) of Texas University studied that Concept Attainment Model was effective for long term retention of learning in all subjects. CAM also enhances and energizes learning in all subjects.

Prichard and Florence Fay (1994) studied that Concept Attainment Model enhance the thinking skills among pupil teachers in a constructive meaningful way.

v) Studies related to problem solving skills
The following studies have been made under this category

Weinert (2001) studied the effect of Concept Attainment Model in solving mathematical numerical problems and found CAM more effective in enhancing problem solving skills among students.

2.2.2 Studies related to CAM in India

2.2.2.1 Studies related to cognitive gain

Researches in the area of models of teaching have mainly seemed to be concentrated upon the Information Processing family. Sharma (1986) studied the effectiveness of CAM in terms of achievement of students on attainment test based on the concepts taught in Chemistry, and the effectiveness of CAM in terms of reactions of students towards the new method of teaching. Sample consisted of 67 students of class IX from Kamla Nehru Girls Higher Secondary School, Indore. He found that the mean performance of the experimental, and control groups on achievement test is significantly different from each other. Students of experimental group have responded favorably towards majority of the statements.

Sushma (1987) studied the effect of CAM based teaching on pupil achievement, the effect of Biological Science Inquiry Model (BSIM) based teaching on pupil achievement, the effectiveness of CAM, BSIM and their attitude towards these Models. The sample consisted of 102 girls of class VIII of Central Hindu School at Banaras. Samanya Mansik Yogyata Parikshan, Socioeconomic Status Index Scale, Uplabdhi Parikshan, Jeev Vigyan ke Prati Chhatra Abhivriti Mapan Suchi, Analysis of Variance, F-Ratio and t-test were utilized. He found that CAM was effective for teaching Biological Sciences to
VIII class students. CAM was more effective than BSIM when students' achievement in Biological Science was taken.

There were some more studies in which the effectiveness of two models has been compared. The maximum numbers of studies were conducted on CAM. Out of the three strategies of CAM, viz., Reception, Selections and Unorganized, the Reception strategy seemed to catch the fancy of most of the researchers. Aggarwal and Mishra, K.S. (1988)\textsuperscript{1} studied the effectiveness of the Reception strategy in enhancing the attainment of science concepts and found it to be effective.

Baveja, B (1989\textsuperscript{a},1989\textsuperscript{b})\textsuperscript{2} 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 analysed the thinking strategies used by the learners. The two studies differed in their sample population and elaboration. The findings are quite similar in the two studies supporting the role of inductive thinking processes in the process of conceptualization and generalization.

Another study Sood, K. (1990)\textsuperscript{3} on comparative 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 in teaching of concepts in Hindi. Intelligence, creative levels and cognitive were redundant factors so far as the learning of concepts were concerned. Singh D.K. (1990) found inquiry training model and CAM are equally effective in the teaching of physical science to class IX pupils than conventional method. There were two studies Kaur, R.P. (1991); Jamini, N.(1991) which aimed
at comparing the effectiveness of AOM and CAM in relation to the achievement and creativity of students. Kaur, R.P. (1991)\(^1\) found that for teaching of concepts in economics both the models are effective. The interaction between teaching strategies, intelligence and creativity were not found to be significant. The study by Jaimini, N. (1991)\(^2\) which aimed to investigate the relative effectiveness of AOM and CAM on conceptual learning efficiency 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 CAM was more effective then AOM in the retention of concepts irrespective of the level of divergent thinking of the pupils.

An elaborate three phase experimental study of CAM and ITM was conducted by Passi, B.K., Singh , L.C. and Sansanwal, D.N. (1991)\(^3\) under the guidance of Bruce Joyce, aimed at finding the efficacy of the training strategy adopted for training application in Indian classroom conditions. This was workshop-based study on development of training in CAM and ITM, which brought about significant favorable changes in the attitudes of both-the teacher educators and the student teaches towards the models. Bawa, M.S.'s study (1991)\(^1\) attempted to review the research possibilities on conceptual learning (Burner's view) and indicated that there is a dearth of research studies in the area of concept learning. Manocha, V. (1991)\(^2\) 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 and CAM more effective than conventional method.

The researchers also focused their attention on comparison of AOM and CAM. 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 superior to the group taught by AOM as well as routine method as far as the teaching ability of student-teachers was concerned. Das B.C. (1993) also studied the effectiveness of CAM and came to the conclusion that CAM was effective in concept building of students. Ananda K. (1996), Meenakshisundaram K.R. (1996), Muthulakshmi (1996), Alam Mohd. Sohrab (1997), Jayabharthi M (1997), Vaidya Shobha (1997) studied the effectiveness of CAM and found that CAM was more effective in enhancing the achievement scores of students. Shanthi (1998) studied the effect of Concept Attainment Model on fifth grade pupils in Science and concluded that CAM is effective in the attainment of concepts in science. T. Kumar Vijay (1998) also of the same conclusion that CAM was more effective in increasing the achievement in science of secondary school students.

Paul Justin T. (1999) studied the efficacy of CAM on higher secondary school students in Zoology and concluded that CAM was more effective than traditional method. Veena Seema (1999) compared the CAM and traditional method in acquiring the science concepts of class VII students and found that CAM was more effective in acquiring the science concepts as compared to traditional method. Pal Ravinder (2000) studied the impact
of CAM on the achievement of secondary school students in science and concluded that CAM was more effective in achievement of science concepts than conventional method. Prabhakaran K.S. (2000)\(^2\) also studied the effectiveness of CAM on achievement in mathematics and after studying concluded that CAM enhances the achievement of students. Kaur Sukhbir (2001)\(^3\) compared the effectiveness of CAM and Advance Organizer Model in chemistry of eleventh class students and found that in relation to achievement CAM was effective than traditional method. Herma Z. (2003)\(^4\) studied the effectiveness of CAM on mathematics achievement of eight grade students and found that CAM was effective in enhancing the scores of student. Nayar Ajitha (2005)\(^5\) studied the effectiveness of CAM in learning chemistry at secondary school level. She took students from two different schools and the two groups were equated on the basis of Dr. A. Sukumaran Nair's intelligence test for the purpose. The CAM was effective in increasing the scores of students.

2.2.2.2 Studies related to Other Areas

i) Studies related to psychological concepts and strategies of learning

The following studies have been made under this category

Pandey (1981)\(^1\) studied the effect of CAM on Science Concept attainment at various levels, to identify the teaching behavior commonly exhibited by Science teachers and determined the effect of individual teaching behaviour on concept attainment at various levels. The sample comprised of 24 post graduate trained male Science teachers having at least 5 years teaching
experience in secondary and higher secondary schools and 300 secondary school students in class 11 from five schools of Varansi. Concept Attainment test and instrument for analyzing verbal teaching behaviour developed by the investigator, group test of general mental ability (Joshi), Analysis of Variance & t-test were used. He found that all teaching behaviour was frequently observed in the Science teachers. The teachers questioning had significant positive effect on both the levels classificatory and formal of concept attainment. Teaching style had varying effects on both the levels of concept attainment as well as total concept attainment. Giving background information encouraging student's participation and student response and giving ample opportunity for students to think in the course of teaching behaviours were conducive to better concept learning.

Bhattacharya (1984)\(^2\) conducted a study on the effectiveness of Concept Attainment Model and inductive model for teaching Geography and found that the models of teaching approach resulted in better achievement in Geography even in average and low resource status educational institutions.

**ii) Studies related to teaching for discrimination and generalisation**

The following studies have been made under this category

Passi, Singh and Sansanwal (1985)\(^1\) studied the effectiveness of training in Concept Attainment Model in terms of understanding and reaction towards to model; the effectiveness of training in Inquiry Training Model in terms of understanding and reaction towards the Model; the resultant willingness of teacher educators to implement the models in teacher education
programmes. They also developed and finalized the measurement tools namely, theory check up and reaction scale separately to implement the models. Concept Attainment Model and Inquiry Training Model and a Scale measuring willingness to implement the Models; and developed a strategy of training in Models of Teaching. They found that training in Concept Attainment Model in the form of lecture, demonstration, discussion and peer practice feedback did enhance the understanding of teacher educator's theoretical aspect of CAM, the training in CAM did bring significant favorable change in teacher educators reactions towards CAM. The level of understanding of CAM did not influence teacher educator's reactions towards CAM; Training in Inquiry Training Model in the form of lecture, demonstration, discussion and peer practice feedback did change the understanding of teacher educators' theoretical aspects of ITM; Training in ITM did bring favorable reactions of teacher educators towards ITM. The understanding of ITM did not influence teacher educators reactions towards ITM. The teacher educators were willing to implement models of teaching in teacher education programme if the support system is available. The training strategy comprising of theoretical discussion, demonstration and peer practice feedback was effective in terms of developing understanding favorable reactions and willingness to implement models of teaching in teacher training programme.

iii) Studies related to transfer of training

The following studies have been made under this category
Das (1986)\(^1\) studied the effectiveness of CAM in terms of teaching competencies (Understanding the model, training the model, reaction towards the model.) of pre service student teacher. Sample consisted of 16 student teachers studying in B.Ed. Dept. of Education, D.A.V., Indore. He found that CAM is effective in developing teaching competencies of pre service student teachers. Training in CAM had affected the teaching behaviour of student teachers of the coaching stage. There was effective transfer of training and CAM had affected the teaching behaviour of student teachers of coaching stage.

iv) Studies related to teacher education programme

The following studies have been made under this category

Bihari (1986)\(^1\) studied the effectiveness of three training strategies in learning CAM in terms of teaching competency of student- teachers; in terms of understanding of the model; in terms of coaching through the model; and in terms of willingness to implement the model. The sample consisted of 55 student- teachers studying in B.Ed. 'B' section of the Dept. of Education, D.A.V. Indore. Teaching analysis guide (TAG), Reactions Scale, Willingness Scale, Analysis of Variance, Analysis of Co-variance & t - test were utilized. The researcher found that the three training strategies namely peer feed back and practice in pairs & demonstration followed by practice were equally effective for developing teaching competence

Antimadas (1986)\(^2\) developed the model competency of pre-service teacher trainees by adopting CAM with three different training strategies. The sample consisted of 55 B.Ed. students of Education Department of Devi
Ahilya Vishwavidyalaya, Indore. 16 P.F. Cattell, Teaching Analysis Guide (TAG) by Bruce Joyce; Factorial Analysis of Variance with unequal Cell Size and one way Analysis of Variance were used. He found that three different strategies were equally effective in terms of model competency of teacher trainees at the end of training and coaching stage.

**Chaudhary, K. (1989)** investigated and found the teaching skills and competence developed among student-teachers through the CAM instead of spending much more time on the microteaching technique to develop the teaching skills.

**v) Studies related to psychological concepts**

The following studies have been made under this category

**Pani (1988)** compared concept attainment scores of group through reception and selection strategies of concept attainment and studied the effect of personality factors on concept attainment scores of two groups. The sample consisted of 30 students of class 8. Concept attainment tests junior and senior high school personality questionnaire Mann - Whitney U - Test were utilized. He found that the reception strategy and selection strategy were equally effective in terms of attainment of Science concepts. **Kumari Raj (1990)** compared CAM and Inquiry Training Model on the basis of teacher appraisal guide and found CAM effective on these variables. JIM was compared with CAM by **Mohanty, B.K (1992)** in development of moral concepts and judgment and the personal values of Class VIII pupils. The findings of the study indicated JIM was more effective for developing the moral judgment and personal values of students whereas CAM was effective
in developing moral concepts. **Khan, Mohd.Sharif and Siddiqui, Mujibul Hassan (1992)**\(^1\) studied the effectiveness of CAM. They found that CAM is more effective than traditional Method and the factors affecting the selection strategies and reception strategies to attain concepts were definition of task, nature of the instances encountered, nature of validation and nature of imposed restriction. Personality factors had no significant effect on the concept attainment process. **Anuradha et.al. (1993)** took an experimental study to find the impact of CAM on general mental ability of social science students and found that mean general ability scores of students taught through CAM significantly higher than traditional method. **Naresh (1995)** compared CAM and Inquiry training model on mental processes and attitude towards science. 140 students of ninth class were selected and found that CAM was effective in developing reasoning ability, science creativity.

**Hussein Jalilvand (1999)**\(^2\) studied the effectiveness CAM on concept learning in relation to the cognitive styles and intelligence at the secondary school stage and concluded that CAM was effective in concept learning. **Parminder (2001)** compared the effectiveness of CAM, Advance Organizer Model and conventional method in relation to intelligence and achievement motivation of class ninth in Physics. He selected 240 students of 80 students in each group of ninth class. Three way analysis of variance, Meenakshi's Socio-economic status scale, Jalota's Verbal group test of general Mental Ability, Achievement Motivation test of Pratibha Deo and a criteria test in Physics. He concluded that CAM was more effective than
conventional method, students with high level of intelligence had better performance as compared to low level of intelligence.

vi) Studies related to language

The following studies have been made under this category

Salvi, R.C. (1991)\(^1\) studied the effectiveness of Concept Attainment Model for teaching concepts of the English language and found it is more effective than traditional method J.V. Asha (2002)\(^2\) studied the efficacy of instructional pedagogy of English based on Ausubel's and Bruner's Model for B.Ed. students and found CAM effective in increasing the scores of the students.

vii) Studies related to discrimination and generalisation

The following studies have been made under this category

T. Vijaya kumar (1998)\(^3\) studied the CAM of teaching on achievement in science among secondary school children belonging to different socio-economic environment and found CAM was effective in enhances the achievement of science students.

viii) Studies related to problem solving skills

The following studies have been made under this category

James (1999)\(^1\) studied the effect of concept attainment and problem solving ability in Mathematics of High School students on some cultural and cognitive effective variables. He found that CAM and problem solving ability affect tremendously by cognitive and effective variables and their achievements showed improvement.
ix) Studies related to curriculum development

The following studies have been made under this category

Ojha, Nitai Charan (2000)\textsuperscript{2} studied the effectiveness of CAM in relation to achievement, retention, self concept and attitude of students towards economics and found CAM effective in achievement retention. He developed the instructional material for teaching economics to class ninth. Siva Kumar (2000)\textsuperscript{3} developed a guided investigation model through information processing approach. He followed the information processing approach for the development of curriculum and found very much effective for the secondary school students. Zaidi Shabana (2000)\textsuperscript{4} developed and validates the Concept Attainment test in chemistry for eleventh class students and she selected the Delhi School students for her study. Fatima Roohi (2003)\textsuperscript{1} studied the effectiveness of CAM and developed CAM test in mathematics for elementary classes. Agarwal Raj (1999) studied the effect of CAM in relation to creativity on conceptual learning of class eleventh students of commerce. She selected 96 students of three groups of 32 in each group. The results of this study have implications for the students in developing their metacognitive abilities for teachers and curriculum and designing of instructional material. Mohan Sunita (2007)\textsuperscript{2} compared the Inquiry Training Model and CAM. She selected 40 students in each group and found that the CAM has its place in increasing the environmental awareness among school children.

The Overview
The review of researches reveals that Science of concept mapping has grown at an exponential pace. Studies show that some specific teaching models are respectively superior for cognitive gain (above content) related to particular subject matter. Few studies are in favour that teachers with additional skills can employ concept mapping. Studies also show that class room teachers motivated to use new meta cognitive learning strategies can be successful in employing concept mapping. The sample of research studies has been selected from different levels. For example elementary, primary, junior, secondary level and higher level.

Most of the studies emphasize to use concept mapping for meaningful learning and increase students achievement. It is evident from the review of researches carried out so far that Concept Mapping can be used as a part of curriculum development process. Few recent studies have also shown that concept mapping seems to be meaningful in Psychological concepts. Several studies emphasize to develop problem solving ability through logical connections cooperatively. The use of concept mapping with library instructions showed that concept mapping can search more thoroughly and more effectively. Few studies show that Concept Mapping strategy was effective in enhancing problem solving ability of the students. The researches have shown the effectiveness of Concept Mapping in terms of pupil learning. Few researches have shown that Concept Mapping Model helps in horizontal and vertical transfer of learning from one level to another level or from one grade to another grade.
While studying the effect of Concept Attainment Model independent variable for example socio-economic status, personality traits, cognitive development of students etc. have been considered. Researches also show that Concept Attainment Model is effective in enhancing concept attainment, reading achievement of children with special needs or from different socio-economic status. Researches shown that Concept Attainment Model is effective in enhancing teaching skills and competencies of the class-room teachers. Many studies are in favor that Concept Attainment helps in developing reasoning abilities and creativity among students of all levels - primary, secondary, higher. Several studies emphasize the use of Concept Attainment Model for enhancing students' cognitive skills, problem solving skills. Concept Attainment Model is used as part of curriculum development process.

Many studies reveal that though different types of organizers including graphic, audio visual have been used, but mostly printed organizers were preferred. Frequently used experimental and quasi experimental designs were non equivalent control group one group pre test two group pre test post test and factorial design. Majority of the researchers used self made tools according to the requirement of study. Standard Statistical techniques such as ANOVA, t test, chi square test and multiple regressions were used by most of the investigators. These studies show that models are superior to traditional method of teaching in promoting pupils' learning.

There is hardly any study to compare concept mapping model and concept attainment model on the criteria of scholastic achievement. So the
present study is an attempt in the direction of comparing the effectiveness of Concept Mapping Model, Concept Attainment Model and Traditional Method of Teaching.