principles and their interrelationships, in ways students can form a conceptual understanding of the subject. Second, they will become skillful in the use of metacognitive tools and thus hold more confidence in using these tools with their own students. The studies by Beybach Smith point to the need for empowering teachers to learn meaningfully so that they can be more successful in helping their own students learn meaningfully.

Concept mapping enables teachers to gain invaluable insights into the cognitive modes of their students (Kinchin, Hay and Adams, 2000) The technique has, therefore, been widely used since the 1980s in an attempt to better comprehend differences in student construction of knowledge and subsequent learning enhancements (Anderson, 1985).

Concept mapping empowers learner to play an active role in the knowledge capture process and enables to build knowledge bases with interconnected sets of linked concept maps and resources of the domain.

Successfully capturing and sharing expert knowledge depends on the ability to elucidate expert knowledge and to represent it in a form supporting examination by others. In the light of the difficulties in capturing knowledge through traditional knowledge engineering processes, there is considerable interest in facilitating the knowledge capture process in particular through methods that allow more direct and natural interactions between system and expert.

Many learners are surprised to see how this simple tool facilitates meaningful learning and the creation of powerful knowledge frameworks that not only permits utilization of the knowledge in new context but also retention of the knowledge for long periods of time (Novak, 1990; Novak and Wandersee, 1991). There is still relatively little known about memory processes and how knowledge finally gets incorporated into our brain but it seems evident from diverse sources of research that our brain works to organize knowledge in hierarchical frameworks and that learning

techniques that facilitate this process significantly enhance the learning capability of all learners.

While it is true that some students have more difficulty in building concept maps and using these, at least early in their experience, which appears to result primarily from years of rote mode learning practice in school settings rather than as a result of brain structure differences per se. So called "learning style" differences are to a large extent differences in the patterns of learning that students have employed varying from high commitment to continuous rote mode learning to almost exclusive commitment to meaningful mode learning.

Concept Maps for Instructional Design:

Because of the flexibility of concept maps, they can be used in a variety of situations for several different purposes such as (i) curricular tools (ii) as instructional tools (iii) as means of evaluation.

(i) Curricular Tool:

Ausubels model of learning emphasizing concept acquisition coupled with a model of curriculum posed by Johnson is a powerful approach to curriculum development within such a framework, concept maps can take on an important role.

(ii) Instructional tool:

One of the instructional use of concept maps is to have students construct maps describing what they know about a given subject area. It is recommended that any student asked to do this be well versed in what is expected of him/her and therefore time must be spent beforehand thoroughly introducing students to the concept. (of the related area).

Secondly these concept maps can also be used as supplements to or substitutes for lectures, laboratories and readings, others considered

the maps valuable review materials that helped to tie different sections of the course together.

Concept maps are particularly useful for representing networks of concepts, where links do not only connect adjacent concepts but are often linked to concepts in different sections of the concept map. The resulting web of concepts increases the number of relationships that connect new information. This type of structural flexibility makes concept mapping highly suitable for hypermedia environments. (Plotnick, 1997; Gaines and Shaw, 1995).

Evaluation :

One of the powerful uses of concept maps is not only as a learning tool but also as an evaluation tool, thus encouraging students to use meaningful mode learning patterns. Concept maps are also effective in identifying both valid and invalid ideas held by students.

Concept Mapping and Academic Achievement :

Analysis on studies using concept mapping as a learning strategy conducted by Horten et. al., (1993) asked following questions to determine.

(i) "What is the effectiveness of concept mapping as an instructional tool for improving student's achievement?

(ii) What's the effectiveness of concept mapping as a strategy for improving student's attitudes?"

The results indicated that concept mapping raised student's achievement on the average as well as a strong improvement in student's attitude.

Although few studies have been undertaken to investigate the relationship between concept mapping and academic achievement. Some

research findings indicate that high achievers construct better concept maps than do low achievers (Lian, 1998). Now the question that arises is that whether this finding still holds true when cross-domain concept maps are constructed? This study, therefore, tries to suggest a model in which the connections among academic competencies and concept mapping abilities are identified from the perspective of brain function.

Cross-domain Concept mapping and Academic Abilities:

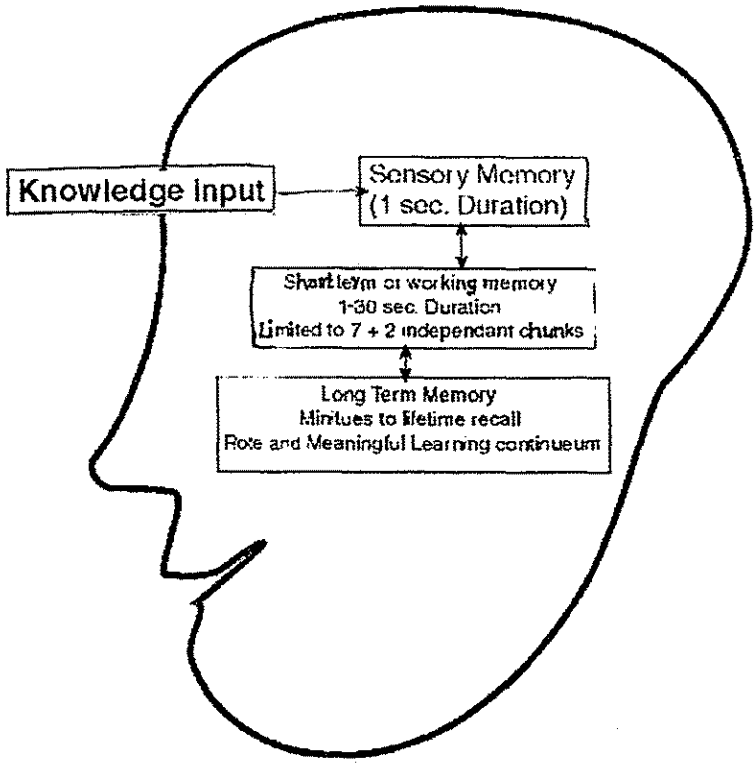
"Cross-domain" concept mapping encourages learners to integrate knowledge from a wide range of disciplines, making meaningful learning more possible.

Earlier studies (Lian, 1998) have suggested that low achievers benefit more from the instruction of concept mapping than do high achievers, whereas high achievers make better concept maps than do low achievers. Unlike most researchers (Anderson Irman & Zeitz, 1993; Santham et al; 1998; McClure etal.; 1999) the investigator attempts to analyze the relationship between academic ability and cross-domain concept mapping by incorporating brain functions and process information theory.

Current brain research has provided a wealth of insight into how the brain passively takes in and actively processes information (Hyerle, 1996, 2000). Brain serves as a pattern detector with the mind playing the role of organizer to classify into schematic patterns and that students inherently seek patterns in nature (Caine & Caine 1994, 1995, Hyerle, 2000; Jensen, 1998).

From the perspective of the information process model, three kinds of memories are fundamental in learning: Sensory memory, short term memory (working memory) and long term memory (Eggen &

Kauchak, 2001). Students actively seeking patterns fortifies their filtering of information from sensory memory to their short term memory. In the meantime their actively detecting patterns in the working memory help student to organize information into schematic patterns, which further contribute to the construction of integrated knowledge in their long term memory. These mechanisms of the brain are fundamental to cross domain concept mapping.



Cross-domain concept mapping : (A Brain function perspective)

During cross-domain concept mapping, students first need to retrieve topic related information from the long term memory in order to come up with as many concepts, definitions, illustrations and as much factual evidence as possible. Such information is derived from both,

domain knowledge and cross-domain knowledge. Then students seek and detect patterns among the retrieved information and represent them in logical hierarchies and classifications. Next they make reasonable connections among the concept and definitions, illustrate and factual evidence. Besides this, the predisposition to seek actively and the strategies used to detect patterns as well as the use of concept mapping help students organize new and formerly acquired information into schematic patterns that make sense to them. In brief, concept mapping allows for flexibility in students formation of cognitive patterns.

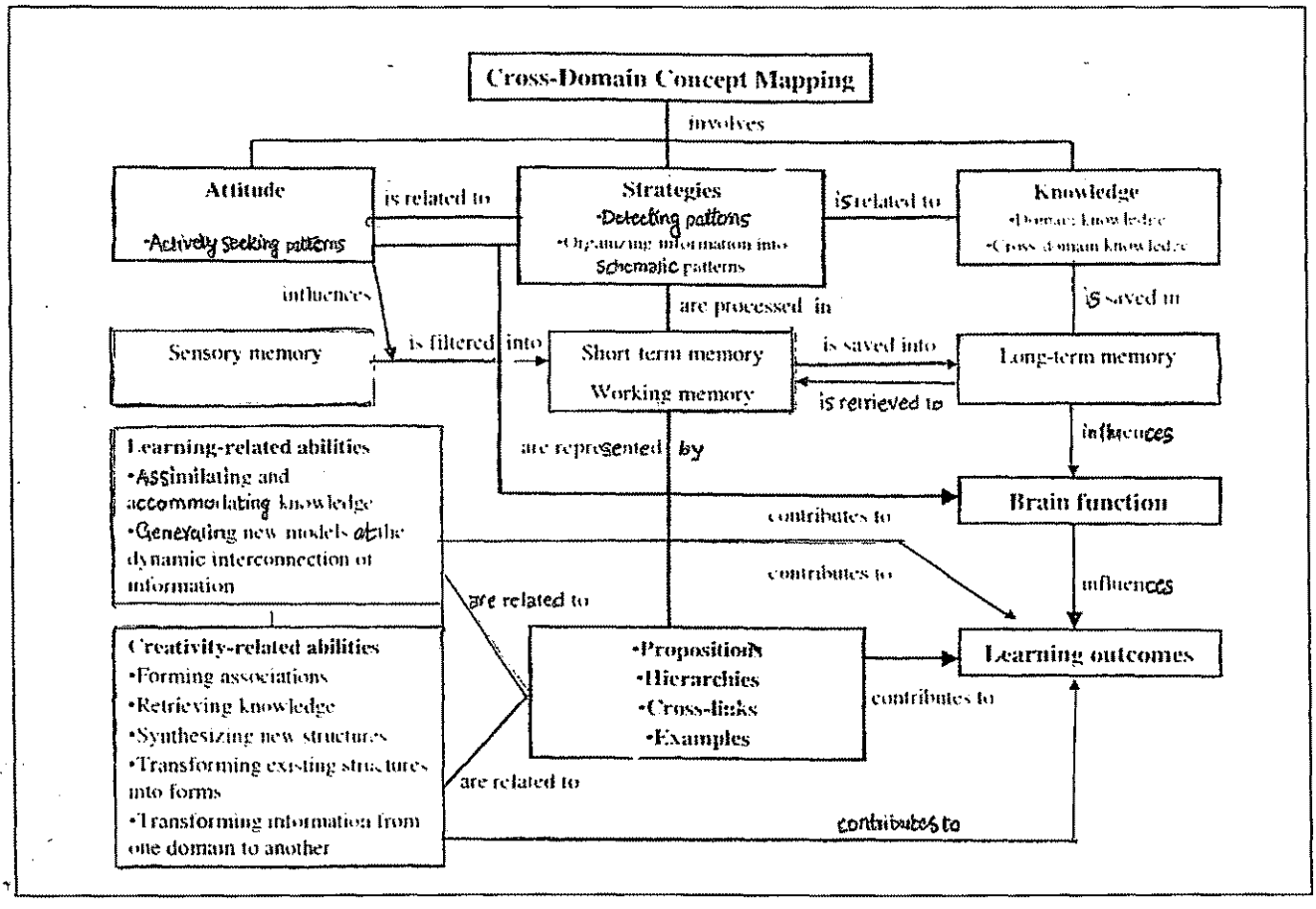
Moreover the analogical transfer of information from one domain to another is especially important to cross domain concept mapping.

The most significant difference between a cross-domain concept map and one that is domain-specific must obviously lie in the "cross-domain knowledge" components. Cross-domain concept mapping necessitates the use of interdisciplinary knowledge.

To avoid rigidity and to be better equipped to come with novel ideas it is necessary that one should think creatively and collaboratively. (Amabile, 1988; Feldhusen, 1995; Runco and Walberg, 1998) claimed that inputs from different domains are essential to problem identification and that the synthesis of such inputs will further influence insight formation. It follows that forming cross-domain map requires the optimal functioning of the brain and this further improves learning outcomes.

Therefore the process of learning and that of making cross-domain concept maps equally require certain abilities and high-achievers should, to some degree, know how to apply such abilities.

Cross-domain Concept Mapping



1.2 NEED AND SIGNIFICANCE OF THE STUDY :

The limited success of students in learning & solving problems reflects more the lack of well-organized conceptual frameworks rather than limitation in their brain functioning due to restricted cognitive operations. Development of well-organized conceptual frameworks require commitment to the meaningful learning both on the part of the learner and the presenter. Meaningful learning requires the learner to seek explicit conceptual linkages between relevant knowledge he/she already has and new knowledge being presented.

Keeping in view, ever-expanding nature of knowledge, a research study on concept mapping is so pertinent to eliminate the bottlenecks in

learning the concepts and enhance learning across all variables of achievers. The study is significant because it stimulates the zeal to learn among learners by making learning an interesting process. In the process, learners imbibe scientific temper and will make learners not to foreclose their imaginative option while learning. This study is an another attempt to reduce mediocrity in learning and open up some new frontiers in learning process of school children.

1.3 STATEMENT OF THE PROBLEM :

The investigator in the present study aims at analyzing the relationship between the academic achievement and the cross-domain concept mapping ability of eighth graders.

"Eighth Graders Academic Achievement and Their Ability to Construct a Cross-domain Concept Map".

(A Brain Function Perspective)

1.4 OPERATIONAL DEFINITIONS OF TERMS :

(a) **Concept Map :**

A concept map is a drawn picture or representation that reflects learner's understanding and interpretation of various aspects of a given topic.

(b) **Cross-domain :**

Interdisciplinary knowledge (based on Ausubel's assimilation theory of cognitive learning).

(c) **domain :**

A set of representations sustaining a specific area of knowledge.

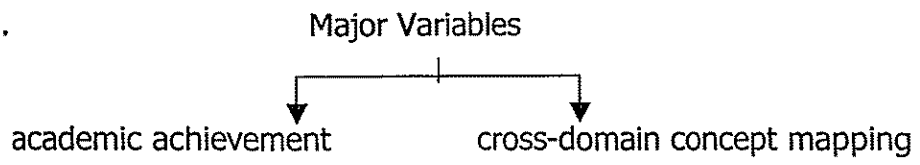
(d) **Subsumption:**

Incorporation of new knowledge into a specifically relevant existing concept or proposition.

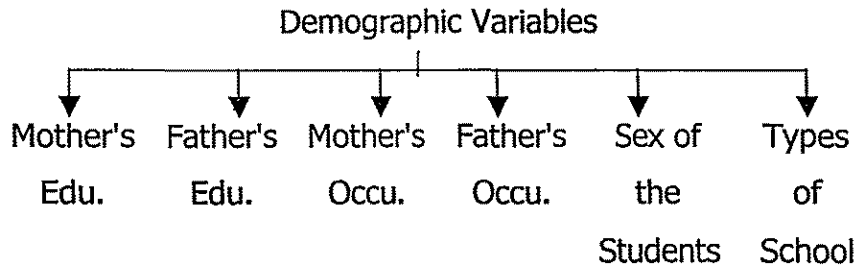
1.5 VARIABLES:

The investigator has divided the variables in two major categories as follows:

a.



b.



1.6 RESEARCH QUESTIONS :

1. Are there any gender differences in the ability to construct cross domain concept map?
2. What is the relationship between a.a. and cdcm$^{hg}_{\delta}$ability?
3. How far is it true that high achievers construct better cross-domain concept maps?
4. Does education of parents play a role in a.a. and c.d.c.m.$^{hg}_{\delta}$ ability of children?
5. Is attitude related with a.a. of a child?

6. Is there any difference between a child whose mother is working and the one whose mother is not working in relation to a.a., c.d.c.m. ability and environmental attitude?
7. How much the different components of two major variables contribute in making them?

1.7 OBJECTIVES OF THE STUDY :

1. To study the relationship between academic achievement and the ability to construct cross-domain concept map.
2. To find if there is any difference in a.a. and the ability to construct c.d.c.m. between the students of K.V. No. 1 and M.G.P.S.
3. To study the gender difference with respect to a.a. and c.d.c.m.
4. To analyze the relationship between a.a. and environmental attitude.
5. To find the effect of parents education on the students a.a., environmental attitude and c.d.c.m^{ng} ability.
6. To find the effect of mother's occupation on the students a.a.; environmental attitude and c.d.c.m^{ng} ability.
7. To find the effect of father's occupation on the students a.a., environmental attitude and c.d.c.m^{ng} ability.

1.8 HYPOTHESES :

Consideration of null hypotheses have been taken in this study :

1. **Ho^{1}** : There is no significant relationship between a.a. of the students and their ability to construct c.d.c.m.
2. **Ho^{2}** : There is no significant relationship between the a.a. of students and their environmental attitude.

3. **Ho^3** : There is no significant relationship between boys and girls in respect of a.a. and c.d.c.m^{ng} ability.
4. **HO_4** : There is no significant relationship between the students of two schools in respect to a.a. and c.d.c.m^{ng} ability.
5. **Ho^5** : There is no significant relationship between mother's occupation and ability to construct c.d.c.m. and a.a. of eighth graders of two schools.
6. **Hp^6** : There is no significant relationship between different categories of father's education in respect of a.a. and c.d.c.m.
7. **Ho^7** : There is no significant difference between different categories of mother's education in respect of a.a. and c.d.c.m.
8. **Ho^8** : There is no significant difference between different categories of father's occupation in respect of a.a. and c.d.c.m^{ng} ability.

1.9 DELIMITATIONS OF THE STUDY

No study is complete in itself and it is bound to have some limitations, which depend on resources, time and sample of the investigator and they are termed as delimitations of the study.

1. The present study confines to eighth graders.
2. The study is conducted on the students of K.V. No. 1 and M.G.P.S.
3. The primary aim of the study is to find the relationship between a.a. and c.d.c.m. ability of the eighth graders.
4. The study is limited to Bhopal city only.

1.10 CHAPTERIZATION :

First chapter deals with background, definition of some terms used in, need and significance of the study, statement of the problem and objectives of the study, hypotheses and delimitations of the study.

In chapter second an attempt has been made to review the related studies to understand and analyze the efforts that have so far been made in the concerned area. Third chapter deals with the research design of the study, sample and population, development of the tool & statistical procedure of the study. Chapter four is concerned with analysis & interpretation of the data. Chapter five reveals in short the major outcomes, conclusions and suggestions for further studies.

CHAPTER - I

INTRODUCTION

1.1 BACKGROUND:

Nobody is born with poor memory. Remembering is a process that must be learnt just like walking, eating, talking, distinguishing colours and sound. According to an experiment our brain can store upto two quintillion bits of information. Scientists say we can compare our brain with a huge disorganized library, which has all kinds of collection of books with no catalogue or systematic arrangement. The need of the hour is to build up a mental catalogue for our brain, which can help us in learning everything very fast, improving our power of retention and helping fast and correct recollection.

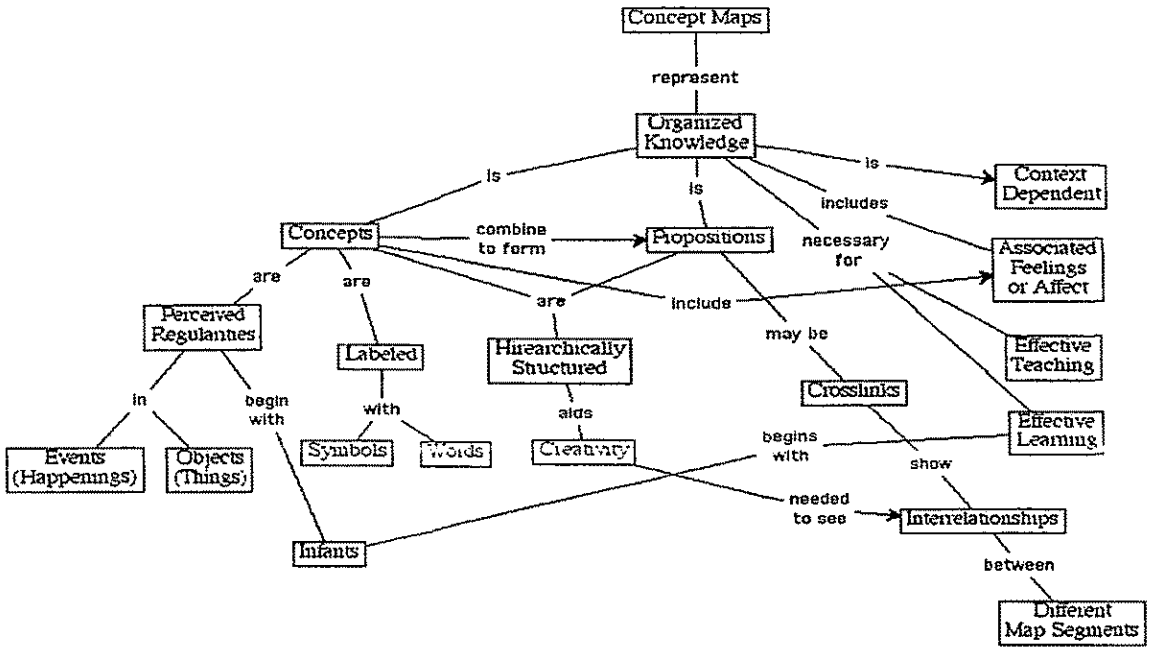
In order to remember well and memorize efficiently one should learn to make associations because memory is nothing but connection of new thoughts, formation of new associations with those which are already stored in the brain, i.e., we learn new concepts only when we get linked or associated with the information/concepts already stored in the brain (B.R. Chowdhary). This is what paves the way for concept mapping.

Concept mapping, developed by Prof. Joseph. D. Novak of Cornell University (1983), is a technique for visually representing the structure of information - how concepts within a domain are interrelated. It is based on Ausubel's theory of meaningful learning, which stresses that learning new knowledge is dependent on what is already known. More specifically, new knowledge gains meaning when it can be substantively related to a framework of existing knowledge rather than being "processed & filed" in isolation according to more or less arbitrary criteria. Concept mapping support the visualization of such conceptual frameworks and stimulates prior knowledge by making in explicit & requiring the learner to pay attention to the relationship between concepts (Jensen,1998).

According to Novak, new concepts are acquired either by discovery, which is mainly the way young children acquire their first concept and language, or by reception learning, which is the way school children and adults acquire most of their meanings. Creating a concept map of a particular domain makes learning an active process rather than a passive one.

Concept Maps : Making the most of your brain

A concept map consists of hierarchically arranged nodes or cells that contain a concept, item or question and labeled links. The relationships between nodes/concepts are indicated by "linking" words and an arrow symbol to describe the direction of the relationships. An example of a concept map, developed by Novak, (1991) showing the key concepts involved is illustrated below:



There are two features of concept maps that are important in the facilitation of creative thinking, the hierarchical structure, i.e., represented in a good map and the ability to search for and characterizing cross links. In a concept map the concepts should be represented in a hierarchical

fashion with the most inclusive, most general concepts at the top of the map. The more specific, less general concepts arranged hierarchically below. The hierarchical structure for a domain of knowledge also depends on the context in which that knowledge is being applied or considered. Therefore, it is best to construct concept maps with reference to some particular question we seek to answer or some situation or event that we are trying to understand through the organization of knowledge in the form of a concept map. Another important characteristic of concept maps is the inclusion of "cross-links". These are relationships (propositions = linking line with linking words) between concepts in different domains of the concept map. Cross links help us to see how some domains of knowledge represented on the map are related to each other. In the creation of new knowledge, cross links often represent creative leaps on the part of the knowledge producer.

A final feature that may be added to concept maps are specific examples or actual images of events or objects that help to clarify the meaning of a given concept.

Concept Map : What all it involves:

a) Thinking:

Thinking involves manipulating and transforming information in memory. This often is done to form concepts, reasons critical thinking and solving problems. The two most important types of thinking which are must to construct a good concept map are creative thinking and collaborative thinking. (Santrock J.W., 2001).

b) Memory:

The most critical memory system for incorporating knowledge into long term memory is the short term or "working memory". To structure large bodies of knowledge requires an orderly sequence of interactions

between working memory and long term memory as new knowledge is being received (Anderson,1993). Concept mapping is powerful for the facilitation of meaningful learning and it serves as a kind of template to help to organize knowledge and to structure it, even though the structure must be built up piece by piece with small units of interacting concept and propositional frameworks.

c) Forming Concept :

Forming concept is an important aspect of constructing information. Concepts are categories used to group objects, events and characteristics on the basis of common properties. They are elements of cognition that help to simplify and summarize information. In the absence of concept we would see each object as unique and would not be able to make any generalization. If we have no concepts, we would find the most trivial problems to be time consuming and even impossible to solve. (Santrock, J.W. 2001)

d) Propositions :

Propositions are relationships linking the concepts with words, phrases or equations between two or more concepts, e.g., understanding the avian world will be to understand the various concepts related to it like birds fly, birds have feathers, birds lay eggs, birds eat worms etc. Thus we see that a concept map is a schematic device representing a set of concepts embedded in a framework of proposition. (Novak and Gowin 1984).

e) Hierarchies:

The hierarchy is economical in storage, viz., that when one learns a new concept subordinate to an existing concept one need not enter all features of the higher node at the new lower one, e.g., if one learns that

eagle is a kind of bird, one may not store with eagle the fact that it flies, has wings and a beak and so on.

f) Cross Links:

Interrelatedness in a concept map indicates an integration of concepts and is depicted as cross-links on the concept map. Cross-links show a relationship between concepts on one branch of hierarchy with concepts on another branch.

Role of Concepts Maps in Education:

In the past decades, a considerable body of research in education illustrates the following common problems of students in acquiring and understanding of scientific concepts and principles:

i) Students are learning predominantly by rote rather than actively seeking and constructing their own meaning for subject matter.

ii) The subject matter remains largely "conceptually opaque" to students and they do not recognize the key concepts nor concept relationships needed to understand the subject matter.

iii) The instruction may fail to present these concepts or concept relationships and thus remains conceptually opaque to the students.

Therefore, the current focus is on cognitive psychology dealing with how students construct and use meanings about how the world works. The limited success of students in learning and problem solving reflects more the lack of well organized conceptual frameworks than limitation in their brain functioning due to restricted cognitive operations.

Concept mapping, therefore, has a variety of applications within a broad range of domains it can be used to:

i) generate ideas - (brainstorming)

ii) design a complex structure

iii) Communicate complex ideas.

iv) assess understanding or diagnose misunderstanding

v) enhance the problem solving phases of generating alternative solutions and options.

vi) facilitate knowledge management.

vii) Analyze organizational decision making processes.

viii) Encourage positive self - concept. (Plotnick, 1998; Gaines and shaw, 1995; Seaman, 1970; Williams, 1997; Bhaduri, S.I. 2003).

To develop well organized conceptual framework requires commitment to the meaningful learning both on the part of the learner and the presenter. Meaningful learning requires the learner to seek explicit conceptual linkages between relevant knowledge he/she already has and new knowledge being presented.

Concept Mapping in Teacher Education :

Teachers face a formidable task, it is their job to do whatever they can, to organize learning experiences in a way that will facilitate student learning. To do this teachers must help students realize what they must do as learners, as well as what they must do as teachers, to achieve what is called "shared meaning of knowledge".

If perspective teachers are to adopt practices that encourage meaningful learning, it seems evident that they must also seek to learn subject matter meaningfully.

The use of concept mapping and other meta cognitive tools in teacher education programs may play a useful role in two ways. First these tools may help prospective or in-service teachers to steer their own learning approaches towards more meaningful (and less rote) practices. They will seek to make subject matter more conceptually transparent (Novak) i.e., they will emphasize the meanings of key concepts and